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KEY TO PRONUNCIATION.

ä	far, father
ā	fate, hate
a or ă	at, fat
ã	air, care
ạ	ado, sofa
â	all, fall
ch	choose, church
ē	eel, we
e or ĕ	bed, end
ė	her, over: also Fr. *e*, as in *de;* *eu*, as in *neuf;* and *oeu*, as in *boeuf, coeur;* Ger. *ö* (or *oe*), as in *ökonomie.*
ẹ	befall, elope
ẽ	agent, trident
ff	off, trough
g	gas, get
gw	anguish, guava
h	hat, hot
h or ʜ	Ger. *ch*, as in *nicht, wacht*
hw	what
ī	file, ice
i or ĭ	him, it
ï	between e and i, mostly in Oriental final syllables, as, Ferid-ud-din
j	gem, genius
kw	quaint, quite
ṅ	Fr. nasal *m* or *n*, as in *embonpoint, Jean, temps*
ñ	Span. *ñ*, as in *cañon* (căn′yŏn), *piñon* (pēn′yŏn)
ng	mingle, singing
nk	bank, ink
ō	no, open
o or ŏ	not, on
ô	corn, nor
ȯ	atom, symbol
ọ	book, look
oi	oil, soil; also Ger. *eu*, as in *beutel*
ö or oo	fool, rule
ou or ow	allow, bowsprit
s	satisfy, sauce
sh	show, sure
th	thick, thin
ŧh	father, thither
ū	mute, use
u or ŭ	but, us
u̇	pull, put
ü	between u and e, as in Fr. *sur*, Ger. *Müller*
v	of, very
y	(consonantal) yes, young
z	pleasant, rose
zh	azure, pleasure
′(prime), ″(secondary)	accents, to indicate syllabic stress

ENCYCLOPEDIA AMERICANA

P

PHOTOGRAPHY. The fact that light visibly affected matter — darkening some that was light and lightening some that was dark, and changing and discharging colors, must have been noticed before history began to be recorded, although it was not till perhaps the fourth quarter of the 18th century that it began to receive anything like systematic attention; not until Scheele, a Swedish chemist, noticing that silver chloride darkened under the rays of the sun, sought for experimental evidence of the cause and consequence. He found that the action was practically confined to the lower end of the spectrum, the blue-violet and the ultra-violet; and that the result was a liberation of chlorine. Scheele was followed by many others, some of whom added more or less to the desired information; but not till 1791 does any one seem to have thought of it as a means of picture-making; at which date there is ample evidence in a book, ‹Tom Wedgewood, the First Photographer,› published in 1903 by Duckworth and Company of London that Wedgewood made photographic copies of pictures, probably using the salts of silver and by «contact printing.» A more or less full account of his methods, written by Davy, appears in the ‹Journal of the Royal Institute› for 1802, but although it is known that he worked with Davy in the laboratory of the institution it does not appear that the latter had any share in the photographic experiments.

To Nicephore Niepce, however, belongs the honor of getting the first camera image, which he did in 1827, although he had been experimenting since 1814; but as, according to Daguerre, it required an exposure of from seven to eight hours, it left much to be desired; and it is safe to say that practical photography was not reached till 1839. Early in January of that year, Daguerre first reported the results of his process and published a description of the same on 19 Aug. 1839. On 31 Jan. 1839, Talbot, who had obtained permanent prints and camera images as early as 1835, reported his process to the Royal Society, and on 21 February following, published the details of the same. In the early part of 1839, Mungo Ponton, in a paper read at a meeting of the Royal Scottish Society of Arts, made known to the world his discovery that soluble organic matter, in the presence of an alkaline bichromate, was rendered insoluble by exposure to light — a discovery the value of which was not recognized for some years, but which is the basis of all that is included in «process work,» or half-tone engraving. See PHOTOENGRAVING.

Daguerre and Talbot had been working independently and without knowledge of each other for several years, the latter alone and on scientific methods, having been a student of science, especially chemistry, from his school days; the former empirically and, for some time before he reached the goal, in conjunction with Niepce. The latter had been working at the problem since 1814. He obtained camera images in 1827, and two years later, at the solicitation of Daguerre, entered into partnership with him. From the documentary evidence available, it is at least certain that the suggestion of the action of iodine on a silver plate — which led to ultimate success — came from Niepce. Be that as it may, it is worthy of notice that, working on different lines and with different material, Daguerre and Talbot found success in the same metallic haloid, the same silver iodide, although made in a very different way and giving very different results. Each was able to secure photographic impressions, one on sensitized paper, the other on a sensitized plate, but were unable to prevent the image from fading out until Sir John Herschel, in 1839, discovered that hypo-sulphite of soda dissolved out the silver unaffected by light, thereby fixing the image. Daguerre's process, to which he had given the name «daguerreotype,» consisted in exposing the highly polished surface of a silver plate, or a copper plate coated with silver, to the vapor of iodine. The silver iodine thus formed passed through various colors, depending on the length of the exposure, and experience soon showed the color which had the highest degree of sensitiveness. This, on exposure in the camera, produced no visible image, but, on exposing the plate to the vapor of mercury (such small quantity as arose from a temperature of about 140°), an image was developed, the mercury vapor having adhered to such parts as had been acted on by light, and in proportion to the quantity or intensity of that light.

The image thus formed was of exquisite delicacy, the minuteness of its detail being limited only by the degree of perfection of the optical appliances; but the process was slow, requiring an exposure of minutes. Prof. John William Draper of the University of the City of New York, with improved lenses early in 1840 made the earliest sunlight picture of a human face by this process. The subject was his sister, Miss Dorothy Catherine Draper. The picture is the property of Sir William Herschell of England. Nearly a year later, Goddard in England and another of the same name in America added bromine, which reduced the exposure to seconds. About the same time an improvement hardly less important was made by Fizeau, known as «gilding,» the deposition of an extremely thin film of gold on the surface of the plate, which materially added to the beauty and permanence of the image. The difficult point about the daguerreotype was that it could not be duplicated nor multiplied except by making duplicate original pictures with a plurality of lenses, as is now done with the ferrotype or tin type. Each exposure yielded a picture complete in itself, but only one, a positive; whereas the altogether easier although apparently more complicated method of Talbot gave a negative that could be duplicated from or multiplied to any extent.

Talbot's process (calotype, he termed it, but better known by his own name) had for its support paper, and according to his first description was made as follows: A sheet of paper was brushed over with a solution of silver nitrate, dried and dipped into a solution of potassium iodide and again dried. This he called iodized paper; it was hardly if at all sensitive to light, and would keep indefinitely. To make it sensitive, it was brushed over with what he called gallo-nitrate of silver, a mixture of solutions of silver nitrate and gallic acid; and after exposure on the camera the image was developed by brushing over with the same solution and the application of a gentle heat. The image so produced was a «negative»; that is, the lights and shades were reversed, darks in the subject being represented by lights or white paper and vice versa. The advantage of this lay in the fact that a sheet of the same paper placed under this negative and exposed to light resulted in a positive, an image in which the lights and darks were in their right position; and that an unlimited number of such positives could be made from such negative. But as positives on calotype paper would require development, the same as the negative, Talbot recommended the employment of the silver chloride paper first brought before the Royal Society, which simply required exposure to light, or what is now known as «printing-out paper.» To facilitate this printing, and to avoid as far as possible the grain of the paper in the paper negative, he subsequently saturated it with wax; and later on, paper iodized and waxed, or «waxed paper,» became an article of commerce.

About 1840 «amateur» photographers came on the stage. Le Gray's wax-paper process, a modification of the talbotvpe, which consisted in waxing the paper before iodizing it, came into use; it was slow yet yielded fine results, so fine, indeed, that some of the negatives made then are quite equal to anything turned out at the present time, notwithstanding all the improvements. The albumen process, first proposed by Niepce de Saint Victor, a nephew of the original Niepce, was perfected by Le Gray about 1850. Iodized albumen was spread on a glass plate and sensitized by immersion in a solution of silver nitrate; and it gave results that for delicacy of detail have not been equaled except by the daguerreotype; results so perfect that for certain purposes — such as transparencies for the stereoscope and for enlarging — it has no equal, and consequently is still in use.

In 1850 the introduction of a practical method of employing collodion as the sensitive film and glass as its support gave photography a new impetus. Collodion, a solution of a variety of gun-cotton, in a mixture of alcohol and ether, was suggested by Le Gray, in 1850; but it remained for Scott Archer of London in 1851 to give it a practical form. Compared with the daguerreotype, it was simplicity itself, while in delicacy of detail and beauty it was not far behind; and more important still, the image might be either positive, so as to be available at once, or negative, with all the advantages of unlimited multiplication. The image on a collodion plate is positive when examined by reflected, and negative by transmitted, light. With a comparatively short exposure and development, the plate needs only backing with some black substance to supply the shadows to convert it into a very beautiful picture. With longer exposure, and development continued until the highest lights are opaque, followed by intensification, it need be, the image is negative, and capable of giving prints of the very highest quality. The developer used is a solution of sulphate of iron and acetic acid, while the fixing agent to fix or dissolve out the film unacted upon by light, is a solution of cyanide of potassium. From this duality of the collodion film there arose two classes of professional photographers, the few, with higher ideals and catering to the better class of the people, adhered to negatives of considerable size, generally «whole plate,» 8½ x 6½ — supplying only one print at a time. The other class, the many, contented themselves with small positive prints, and the «carte de visite» soon displaced the glass positive, or, as it was called in America, «ambrotype.»

But collodion, or wet collodion, as in the light of after developments it was called, however convenient for the professional, heavily taxed the amateur who went afield. The plates had to be prepared and finished on the spot which entailed, even when only the smaller sizes were used, the transportation of an amount of apparatus and material that would greatly incommode a modern amateur. This led to a demand for a process that could be employed in the field as easily as wax paper, and, after many attempts, the result was what was then known as «dry collodion,» 1856–57. A dry collodion plate differed from a wet in having the free silver nitrate washed away; but if then dried and exposed, only a weak, useless image could be obtained, as it required something to take the place of the silver as an absorber of the liberated iodine and bromine. This absorber, or sensitizer, as it was called, consisted first of certain preparations of gelatine, then tannin, and ultimately almost any kind of soluble organic matter, tea, coffee, malt, beer, albumen, etc. Such plates were slow, 5, 10 and 15 minutes being quite usual, even on well-lighted landscapes, and although it was a great relief to have nothing to take to the field but a dozen plates in half as many double slides or plate-holders, the amateur was not satisfied.

The next step in advance was the introduc-

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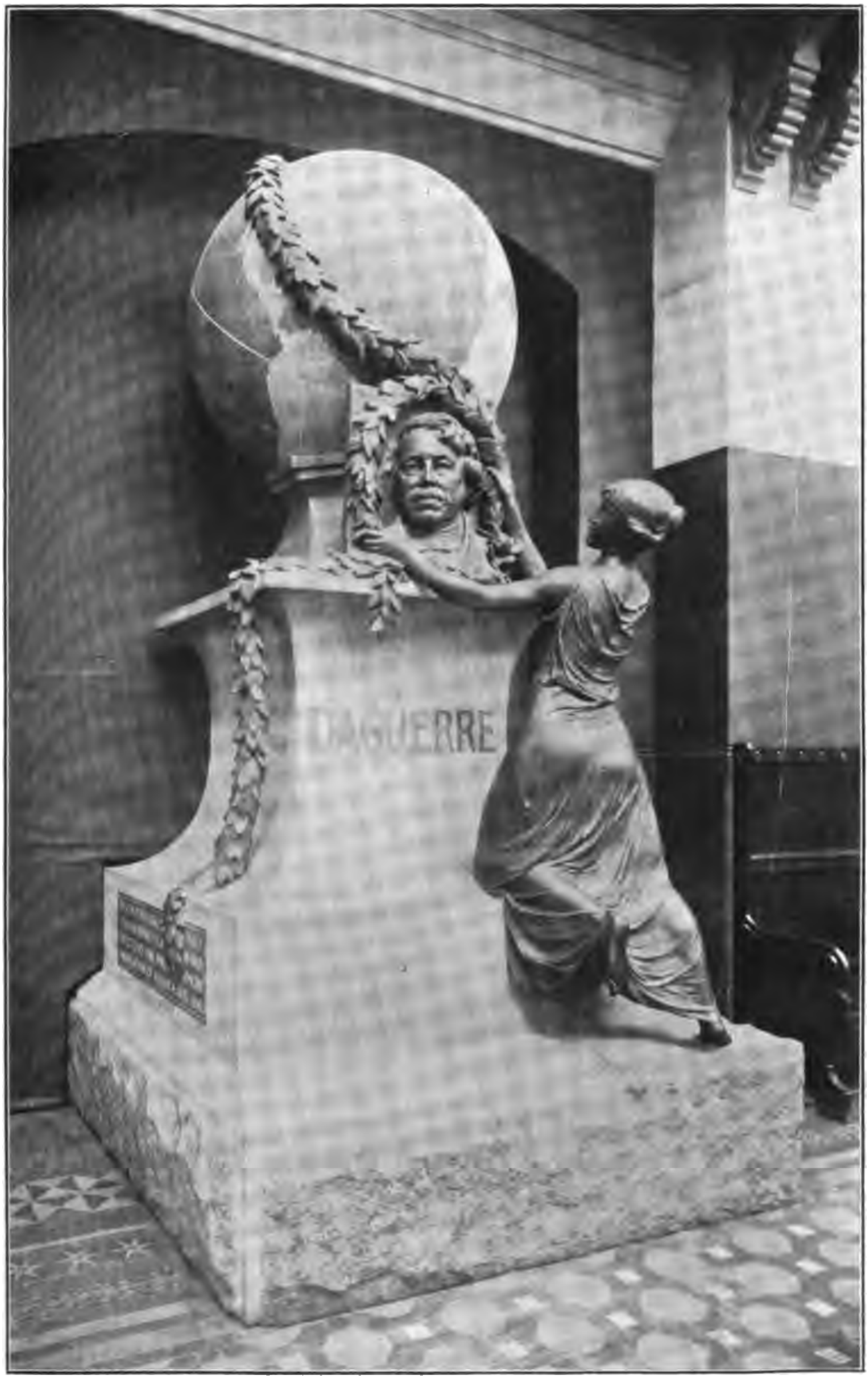
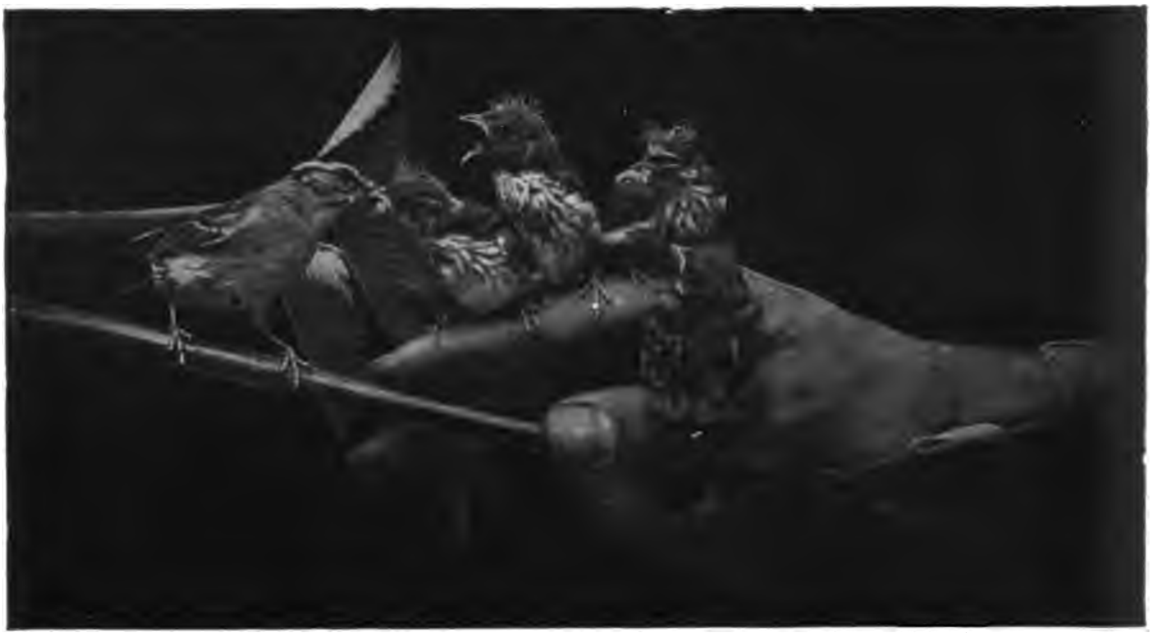


Monument in the National Museum, Washington, D. C., to Daguerre, the discoverer of the art of photography



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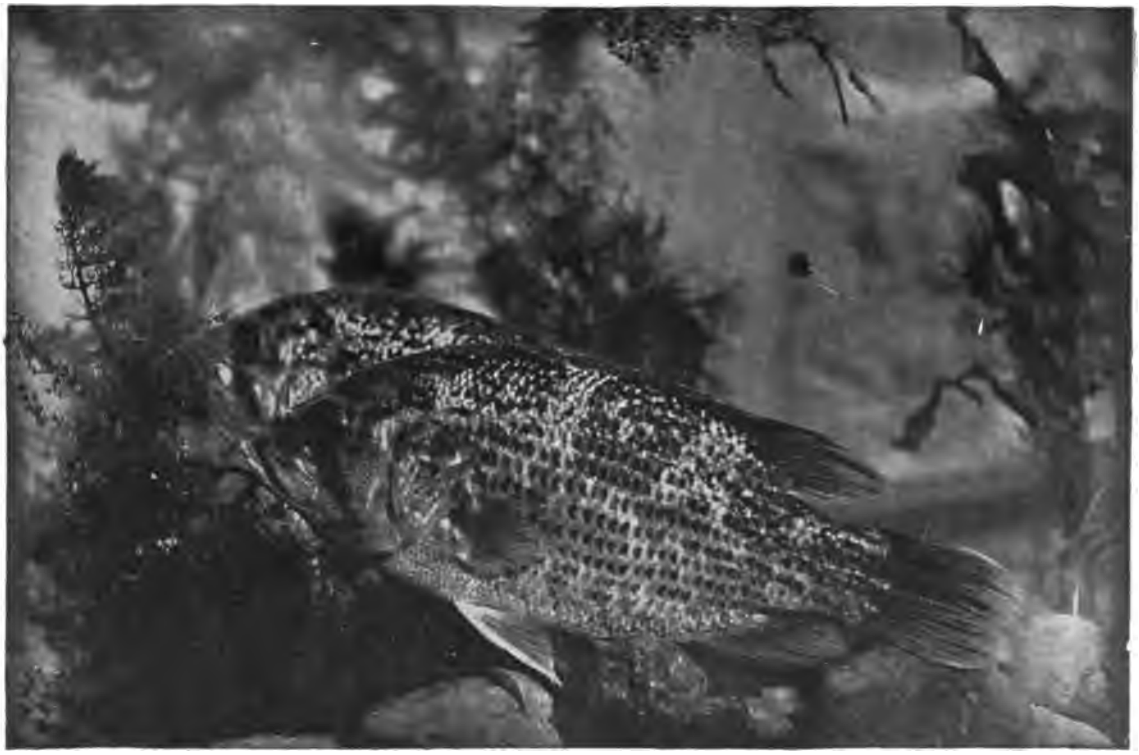
A BROOD OF WILD CHIPPING SPARROWS

Photographed on the author's hand by himself, using an air bulb and long tube. The mother bird is feeding her young, and the other parent flew just as the exposure was made



ROCK BASS

Photographed in water

tion by Sayce and Bolton of the «collodio-bromide emulsion in 1864-65.» This did away with the troublesome preparation of the plate in the silver bath, it being only necessary to pour the sensitized emulsion directly on the plate and set it up to dry. Exposures were now much shorter, but still far behind wet collodion, and so the search for greater rapidity continued. Henry J. Newton, in 1870, prepared a collodio-bromide emulsion of considerable sensitiveness, which was successfully used prior to the introduction of the faster process. The emulsion idea was really the turning-point. In 1871 Dr. R. L. Maddox of England, while using photography as an aid in his microscopical work, discovered the possibilities of an emulsion composed of isinglass, gelatine and bromide of silver, and published a description of his process that year in the *British Journal of Photography*, submitting specimen negatives to the publishers. His process may be said to be the beginning of the now universally used gelatino-bromide process, commonly known as the «dry plate» process. In the preparation of the emulsion, only certain kinds of gelatine are suitable, and much time was spent in discovering which was the best. King, in 1873, improved the emulsion by washing out the free silver, thereby increasing its rapidity. In the same year Burgess began the manufacture and introduction of prepared plates. Bennett in 1874 sold dry sensitized emulsion or pellicle which could be prepared for coating plates by simply dissolving in hot water. In 1878 Bennett made a great step in advance by «cooking» or heating the emulsion at a given temperature. This wonderfully increased the sensitiveness of the emulsion to light to such an extent that glass plates coated with a film of it became from 30 to 50 times more sensitive to light than wet collodion, which was then considered standard. At a meeting of one of the London societies, Bennett showed full-timed negatives made with such brief exposures as to fairly astonish those present. Mockhoven in 1879 discovered that by the introduction of ammonia into the emulsion remarkable rapidity was obtained nearly equal to the «boiling or heating» method of Bennett. Very soon several dry plate manufacturers began to supply the prepared plates for the use of photographers. About 1880-81 plates began to be made in the United States by Cramer and Norden, photographers in Saint Louis, Mo., and John Carbutt in Philadelphia. It was a new industry, for theretofore photographers were required to prepare their own plates.

In 1884 A. L. Henderson, an English photographer, demonstrated before the Society of Amateur Photographers of New York, the process of making a gelatino-bromide emulsion. The general process is shown in the following formula as used by Henry London:

First make the following two solutions:

No. 1.

Bromide of potassium	20 grams
Gelatine, Nelson's No. 1	3 grams
Iodide of potassium	4 grams
Distilled water	170 c. c.
Alcohol, 95 per cent	25 c. c.

No. 2.

Nitrate of silver	25 grams
Distilled water	170 c. c.

Then make

No. 3.

Heinrichs' special gelatine	34 grams
Nelson's No. 1 gelatine	4 grams
Distilled water	180 c. c.

Each of the above solutions may be prepared separately, in ordinary light. Solution No. 1 is placed in a water bath of warm water, and constantly stirred with a glass rod; when all the ingredients are completely dissolved, it is tested with blue litmus paper for acidity; if not acid, it is made so by the addition of enough of the following to turn the litmus slightly red:

Distilled water	5 drams
Acetic acid	1 dram

No. 1 solution is thoroughly mixed by being placed in a hot water bath and agitating, then in a darkened room illuminated only by a faint non-actinic light. No. 2 solution is mixed with No. 1 solution in the form of a fine stream so that the silver may come in contact with the bromide and be converted into bromide of silver. After cooling to 90° F. a solution of alcohol 5 cubic centemeters (nearly 2 drams) and ammonia (Sp. Gr. 910) — 110 minims is added a little at a time. The emulsion is then kept under heat over night at a temperature of 100° F. and solution No. 3 heated up to 125° F. and then cooled down to 100° F. is added to the sensitized solution. The whole is allowed to cool until it solidifies into the form of a jelly, this is compressed and sifted through a screen until it is broken up into small particles and is then washed for several hours. The water is drained off and the emulsion dried. It is then melted at a temperature of 135° F. and 20 cubic centemeters of alcohol is added. Is filtered while liquid in a warm condition, and then coated upon leveled glass plates usually placed upon a marble slab. On cooling the film solidifies, the plate is then removed and placed in a drying closet. After this operation it is ready for use in the camera.

The foregoing is the basis of the process now used by all the large manufacturers of dry plates, who consume many tons of silver gelatine and glass to supply the demand. Specially constructed machinery is used for preparing and coating plates and paper with the sensitive emulsion on a large scale. To explain the magnitude of this work, there was made in 1903 a single positive print on gelatino-bromide paper in Germany 40 feet long by 5 feet wide. A special building was constructed to hold the immense reel, over 13 feet in diameter, on which the exposed paper was wound and developed.

The convenience to the novice or skilful photographer of having a sensitized plate ready prepared and capable of being used at any time, gave a great impetus to photography, and extended its field of usefulness in a remarkable degree. The great sensitiveness of the plates facilitated the practice of instantaneous photography which led to the manufacture of the hand camera, an instrument carried in the hand by a handle, having a finder for locating the image to be photographed, a shutter adjustable for rapid or slow exposures, and a focusing device so arranged that the instrument can be used at a moment's notice without the aid of a tripod. The first practical machine of this kind was ininvented by a German, M. Schmid, and was introduced by E. and H. T. Anthony and Co. of New York in 1884-85. It was found that the sensitized solution could be applied to celluloid transparent film as well as to plates. This lightened the work of the photographer and avoided the danger of breakage which the use of glass entailed. John Carbutt of Philadelphia was the first to introduce coated cut celluloid films in 1883. In 1888 there was introduced by George Eastman of Rochester, N. Y., a new miniature hand camera named the «kodak,» which carried spools or rolls of paper sensitized with a film of gelatino-bromide emulsion of sufficient length to take at least 100 small pictures about three inches in diameter. After each exposure the paper was reeled off, bringing a fresh surface behind the lens. The spool of exposed paper was removed in a dark room and developed there. From the paper negatives thus obtained, prints were made on the same plan as from the paper negatives made by Fox Talbot. Or by a tedious process the developed gelatine film was removed from the paper support and mounted upon a transparent gelatine sheet, which avoided the grain of the paper. A year later improvements were made in the manufacture of celluloid films, whereby they could be produced in long strips, and these supplanted the paper at first employed. The film of the present day is simply a refinement of the first celluloid rollable film, with the additional improvement that it is wrapped in an extra length of non-actinic opaque paper, allowing the roll to be inserted in and removed from the camera in open daylight, thereby dispensing with the usual dark room. The rollable film is of great utility to tourists and others. The manipulation of the gelatine film requires the use of cool solutions not exceeding a temperature of 80° F., on account of its tendency to soften and dissolve away if too warm. This tendency is checked by the use of alum or formaldehyde.

On the Continent, in the United States and some other countries, the ferrous oxalate developer (first proposed by Carey Lea in 1878) was at first preferred for developing the bromide film either on plates or paper; it is prepared by mixing two chemicals separately. First a saturated solution of neutral oxalate of potassium is made acidified slightly with oxalic acid, then a solution of sulphate of iron 500 grams to 1,000 c.c. of water slightly acidified with sulphuric or acetic acid. Prior to development one part of the iron solution is mingled with six parts of the potash solution, which makes a sherry-colored solution. In this several plates or sheets of bromide paper may be successively developed. In England the pyro ammonia developer was preferred and is prepared by dissolving about four grains of pyrogallic acid in one ounce of water and adding a drop or two of strong ammonia. The negative obtained had a brown and yellow color rendering it a slow printer. In 1882 Herbert Berkley discovered that a small quantity of neutral sodium sulphite added to the pyro ammonia developer retarded the oxidation of the developer and prevented the yellow pryo stain yielding negatives of a bluish black color.

Soon after this, in the United States, prior to 1884, H. J. Newton suggested the use of sodium carbonate (ordinary sal soda) as a subsitute for the alkali ammonia in the pyro developer, which with sodium sulphite made a solution that was particularly adapted to the production of negatives having quick printing qualities. The sodium sulphite prevented the yellow stain, and the carbonate of sodium was more stable than the evaporating ammonia.

The proportions of the developer were:

Sodium sulphite	185 grams
Pyrogallic acid	30 grams
Water	500 c. c.

ALKALINE SOLUTION

Sodium carbonate (crystals)	125 grams
Water	500 c. c.

For a developer, 30 c.c. of pyro solution and 30 c.c. of alkaline solution are put into 185 to 305 c. c. of water. It was found about this time to obtain the best results on plates having had instantaneous exposures, that potassium carbonate as an alkali superseded soda, and this is largely used at the present time, in combination with soda, particularly for the development of shortly-timed plates. In 1889 and since then the new coal tar developing agents were introduced under the name of eikonogen, metol, glycin, ortol, etc. They largely take the place of pyrogallic acid. The fixing agent for dissolving out the creamy unacted-upon film after development is hyposulphite of soda.

Printing methods in photography have been as varied and their improvements as great as in the case of the negative. At first prints were made on plain silver chloride paper, and when the ammonia-nitrate was substituted for the plain nitrate, some were made that are not excelled by anything at the present day. The desire for greater detail, however, brought into use albuminized paper, which not only came into universal use, but held its sway until comparatively recent times. About a decade ago it was displaced by paper coated with a chloride emulsion, a highly glossy family, generally known as the «aristo.» This still continues in use and is largely used in prints intended for process reproduction, on account of the clear rendering of fine details. For truly pictorial work methods which give «mat» or plain paper prints are preferred. The principal, or the most generally employed, are the «carbon» and the «platinum» methods, both introduced in the '60s' though both lay dormant for many years.

The carbon, probably the best of all printing methods, although platinum is a close second, is more of a mechanical than a chemical process. It uses a paper coated with bichromated gelatine, colored with finely divided carbon or other pigment. This is exposed under a negative, and wherever light has reached the «tissue,» as it is called, and just in proportion to the quantity or intensity of that light, the gelatine becomes insoluble. Immersed in warm water, the soluble parts of the tissue (those protected by the opaque or semi-opaque parts of the negative, and consequently the lights of the picture) soften and are washed away. Who first proposed carbon is uncertain. Fargier, in France, was early in the field, but to Swan of England is due the credit of first making it a practical process; although Blair of Perth, Scotland, was the first to recognize the crucial part of it — the necessity for *exposing through the back of the tissue*, or in other words, developing from the side opposite to that which was exposed. Platinum was introduced by Willis of England in 1874, and is based on the fact that a platinum salt is reduced to its metal in the presence of potassium oxalate and a ferrous salt of iron. At first the paper was coated with the ferric salt of iron and exposed to light under the negative, the light changing the ferric to the ferrous salt. Development was effected by a hot solution, a mixture of the oxalate and the platinum salts; but more recently the platinum has been mixed with the iron, and development carried on in a cold solution of potassium oxalate.

During recent years two modifications of the carbon printing process have come into pretty general use, especially among pictorialists; «gum-birchromate» and «ozotype,» They are simpler than the original method, do not reverse the image, need no transfer and are supposed to give greater control.

In the gum-bichromate process, paper is evenly coated with a suitable mixture of gum-arabic, coloring matter and potassium bichromate, and dried. It is printed under a negative in the ordinary way and developed by floating on water of suitable temperature, assisted by brush action, letting the water fall in streams and sometimes mixed with sawdust to assist the removal of color from the lights.

In the ozotype process perfected by Manly, paper is coated with a patented sensitive solution consisting of potassium bichromate and certain other salts, dried and printed as in gum-bichromate; and may then be kept indefinitely. To develop the print the printed paper, with a slightly visible image, is soaked in a solution of hydroquinone acetic acid, copper or iron sulphate, etc., according to the effect desired, and, under the solution, brought into contact with a piece of carbon tissue, or the "plaster" prepared by the patentee. Development takes place in warm water, the coloring matter of the plaster or tissue adhering to the parts of the print acted on by light. The ferro prussiate process (blue print process) was discovered in 1842 by Sir John Herschel.

Not the least important of what may be called the side issues, or secondary applications of photography, are the various productions used in printing. See PHOTO-ENGRAVING.

Photography in natural colors, or, as Sir W. de W. Abney has it, in the colors of nature, has been the dream of many experimenters; but, notwithstanding all that has been done, we are no nearer it than when they began. Color photography, however, that is, photographs having the semblance of the natural colors, has made considerable progress. Becquerel was the first to secure on silver chloride something approaching the colors of the spectrum, but got no further; and to Ducos du Haroun is due the credit for, in 1869, clearly foreshadowing the three methods which include all that has as yet been done in it — the superimposing of three-color images, Joly-McDonough colored lines, and Lippmann's interference process. Taking them in the order of their least importance, Lippmann's method is to expose a very thin sensitive film backed by mercury as a reflector, to the colored object. Incident light reflected from the metallic mirror in contact with the film results in interference, and, as the constituents of white light are of varied wave-length, produces in the film a series of planes parallel with its surface, emitting colored light exactly as does the soap-bubble; but the process is difficult, and not likely ever to be more than a scientific curiosity. In the Joly-McDonough method a negative is made in the ordinary way, but with a glass plate with closely ruled colored lines in front of and in contact with the sensitive plate. From the negative so made a positive is printed, and a second or viewing screen with similar colored lines is placed in contact with it, and in exact register with the impressed lines, the result being a picture in the semblance of the natural colors.

An improvement over the screen color lined plate was made in 1906 by August and Louis Lumière of Lyons, France, manufacturers of plates and films, by the introduction of single glass plate coated with a special transparent film, upon which is sprinkled a composite mixture of colored microscopic dust-like starch (potato starch) grains, colored respectively orange, green and violet, there being about 5,000,000 colored grains to the square inch. After the plate is thus coated it is brought under pressure by special mechanical means which flattens out the minute colored starch grains, causing them to merge into each other, giving the appearance, under the microscope, of a mosaic formation. Viewed by transmitted light, the screen appears to have no color.

Upon the screen film thus formed the orthochromatic silver sensitized gelatine emulsion is flowed, and when dry the plate is packed ready for use in the camera, like an ordinary dry plate, except that it is inserted in the plate holder film side down, against a sheet of black surfaced paper, which comes with a box of plates. Thus the glass side of the plate is next to the lens.

A special yellow colored filter intended to absorb a portion of the blue rays of light is interposed in the camera between the lens and the plate. The light from the object to be photographed, after passing through the lens and color filter, first impinges upon the glass side of the color sensitive plate, then penetrates the screen film and lastly acts upon the back of the sensitized film, affecting the film automatically in proportion as the color particles of the screen film transmit the colors of the object photographed to the sensitized film.

The exposure of the plate in the camera for any given stop or diaphragm is usually about 50 times longer than for an ordinary fast plate. The developer used is of the metol-quinone type, having liquid ammonia as an accelerator.

After exposure, the developer (at a temperature of between 60° to 65° F.) is applied to the plate (placed in a tray) preferably in a room that is perfectly dark, for two and a half minutes. It is then poured off, the plate rinsed with water, then a reversing solution (permanganate of potassium) is applied (under a bright light) for three minutes which dissolves away the black reduced silver negative image, converting the same into a positive image. The plate is next rinsed under the tap and the same developer is again used in the tray a second time in bright daylight, which converts the unreduced bromide of silver (or what would represent the shadows in the original negative image) into dark metallic silver, and thus completes the manipulation required to make the transparency. The plate, after removal from the developer, is washed under the tap for a brief period, and, on viewing the same by transmitted daylight, a beautifully colored transparency, possessing all the gradations of the color of the original, is observed.

The operation is nearly as rapid as that of making an ordinary tintype. The finished picture is termed an "autochrome," since its coloring is automatically obtained.

The "three-color" method is the most important, as it has the greatest commercial possibilities, and gives the most varied and most satisfactory results. Although Collen, in 1865, was probably the first to suggest the method, and du Haroun, in 1869, outlined it clearly, they and those that followed them were on the wrong track, working on the theory of Brewster, which never could lead to success, instead of that of Young, Helmholtz and Maxwell, now universally accepted. The first to recognize this was Fred E. Ives of Philadelphia, and to him more than to any other, or indeed to all the others together, are we indebted for the great progress that has already been made. The first experimental half-tone three-color plates and prints were made in 1881.

In 1910 Mr. Ives introduced an improved system of color photography by which duplicate color photographs on a transparent film were obtained. In a specially constructed camera three sensitized dry plates, two of which were sensitive to red and green rays of light and one to blue rays, were exposed simultaneously, after passing through the single camera lens, between which and the plates was interposed a yellow-orange transparent light filter or screen for the purpose of reducing the strength of the blue rays.

The three sensitive plates were enclosed in a single plate holder, specially designed, so arranged that two of the plates were placed film sides in contact and a third, a trifle smaller in size, with the film side against the glass side of one of the two plates in film contact. The three plates were secured together at one edge bv a flexible paper hinge and the whole was named a «tripack.»

To make an exposure in the camera (after focusing) the holder (containing the three plates) is inserted like an ordinary plate holder in the usual way. On withdrawing the plate holder slide, the smaller plate in the holder falls out by gravity and rests on the bottom of the camera in a horizontal position, but the other two plates are held in the holder in a vertical position. After this operation a second yellow tinted transparent plate on the interior of the camera was dropped by a lever on the exterior, downward from the roof of the camera in front of the tripack plate holder at an angle of 45 degrees, the top of the plate being nearer the lens than the bottom, and formed a transparent reflection since its location was over the smaller sensitive plate lying on the bottom interior of the camera. Part of the light from the colored object, after passing through the camera lens and the yellow absorption filter, is reflected downward by the transparent reflector upon the two horizontal blue sensitive plates, while the rest of the light continues on in a horizontal direction, striking the underside first of the red sensitive plate film, passing through the same and acting upon the face of the yellow-green sensitive plate film in contact therewith. Thus three plates are in focus and exposed at one time. After exposure the angular filter screen plate is carried back to the camera roof, a lever on the outside raises the horizontal smaller plate into the plate holder till the plate holder slide is pushed in. The three exposed plates are each marked to indicate their respective color sensitiveness and are then developed as a unit in a tank developer for a specified time. Each image is distinct and sharp and exactly the same size. The duplicate positives are made from the three negatives upon a transparent film sensitized with a gelatine bichromated solution, printed in a printing frame in sunlight all three at one time, fixed in warm water. Where the light has acted, renders film absorbent to color. Each respective film picture is next dipped in its blue, red and yellow dye solution, washed, and when dry are clamped together so that images perfectly match between two pieces of glass, with the result that a beautifully brilliant colored very transparent picture, true to nature, is obtained. See COLOR PHOTOGRAPHY.

A serious objection to silver-bromide, the sensitive salt in the ordinary photographic plate, is the fact that it is so much more sensitive to the blue-violet than to the green and red of the spectrum as to give a very false rendering of color values or luminosities, the darker colors showing as the lighter and vice-versa. Dr. W. H. Vogel was, perhaps, the first to find that the addition of certain dyes to the emulsion tended, to a large extent at least, to equalize the sensitiveness; and to plates prepared with such an emulsion or soaked in the dyes after preparation, he gave the name of orthochromatic or isochromatic. But even the most evenly sensitive of such plates are still more sensitive to the blue-violet than to the red and green and for the best results — the true rendering of color luminosity, it is desirable to employ color filters or screens that will absorb the excess of blue-violet.

The beginning of the moving picture idea was early in 1878, prior to the introduction of the present rapid dry plate, by E. J. Muybridge, a photographer in San Francisco, Cal., who photographed the movements of a racing horse owned by Leland Stanford by having a series of individual cameras placed in a row about one foot apart, the shutters of which were electrically operated automatically, as the horse moved forward. This first experiment proved that a trotter's feet are entirely off the ground together twice during the making of a stride. In 1896 Edison and others perfected the moving film system in combination with a shutter. See MOVING PICTURES.

In scientific investigation, photography has been remarkably helpful. It has taken the place of manual labor in record-keeping, measured the velocity of flying bullets, shown the true positions of animals in motion and created the «new astronomy.» As early as 1840, Draper had made photographs of the moon; in 1857 De la Rue established heliographic observation of sun spots, a work begun at Kew and continued at Greenwich till the present time. Employed in every solar eclipse since 1860, photography has told us all that we know of the corona and chromosphere; it has revealed the mystery of the hitherto puzzling nebulæ, and, by virtue of the fact that the light action is cumulative, has told of the existence of stars so far away as to be beyond the ken of the human eye, aided by the most powerful telescope yet made. At the Astro-photographic Congress that met in Paris in 1887, it was resolved to make a photographic survey and star-map of the heavens and at present there are 18 telescopes, each of 13-inch aperture, engaged in that work in various parts of the world, while in most of the more important observatories protography and the spectroscope are joined together and made daily, or rather nightly, to tell us more and more of the mystery of the heavens.

As an educational adjunct, photography has played an important part. The projection lantern finds a place in every well-equipped lecture-room, and the photographic lantern-slide lends itself equally to the teaching of science and the illustration of travel. The beauty and accuracy of the photographic lantern-slide and the ease with which it is made make it equally available to the college professor and the itinerant lecturer, enabling the one to show to a whole class what otherwise would require to be handled by the members one by one; and giving to the other an opportunity of making a comfortable living and in some cases amassing a fortune, by amusing and instructing the popular audience. Hardly less important, although much less popular, is the enlarging of small objects, «photomicrography.» In bacteriology, histology, etc., its importance can hardly be overrated, affording, as it does, illustrations in works dealing with such subjects that are without a suspicion of the imperfections of draftsmanship and showing, as they do, when orthochromatic plates are employed, the different luminosities of the various stains.

Nor is photography less important from a social point of view. While it displaced miniature painting, a style that only the rich could enjoy, it gave a better likeness of loved ones equally available to rich and poor. It has given us correct instead of fancy or distorted views of the manners, customs and scenery of distant lands; enabled the cottager to decorate his walls with better pictures than were available to his richer neighbor previous to its advent and given a new interest to periodical literature by the low cost and excellent quality of its illustrations. Not less wonderful has been its influence commercially. It has created new branches of trade and manufacture and largely increased many that were in existence before, furnishing well-paid work to hundreds of thousands of both men and women. The glassmaker and the optician have wrought together till they have given us lenses as nearly perfect as we can hope to see; the chemist has given us new material and improved the old, building factories for the manufacture of some by the ton that, previous to the advent of photography, were only known as curiosities of the laboratory; while the camera-maker has so exercised his ingenuity as to give us cameras of perfect workmanship and almost automatic in their action. In 1914 there were 87 establishments in the United States manufacturing photographic apparatus, of which 21 made almost exclusively cameras and 21 motion-picture machines. In the same year there were reported 59 factories making photographic materials of the gross value of $4,273,000. This latter industry employed 6,658 people and made gross products of $34,768,000.

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PHOTOGRAPHY IN COLOR. See COLOR PHOTOGRAPHY.

PHOTOGRAVURE, fō″tō-grā-vūr′, a process of engraving in which, by the aid of photography, subjects are reproduced as plates suited for printing in a copper-plate press. The process known as heliogravure is essentially the same. See PHOTO-ENGRAVING.

PHOTO-GLYPTOGRAPHY, that department of photo-engraving in which the plates are in intaglio. See PHOTO-ENGRAVING.

PHOTO-HELIOGRAPH, an instrument for observing transits of Venus and other solar phenomena, consisting of a telescope mounted for photography on an equatorial stand and moved by suitable clockwork.

PHOTO-LITHOGRAPHY, a method of producing by photographic means designs upon stones or zinc or aluminum plates, from which impressions may be obtained by lithographic process. The first requisite for the production of a good result by this process is a suitable original. The drawing should be made with perfectly black lines throughout, no matter how thin the lines are; the scale of reduction should not be too great; the best proportion is obtained when the drawings are made about one-third larger than the required block; the paper used should be white and smooth in texture.

The negative for a line-block is made preferably by the wet-plate or collodion process, because of the facility with which these plates can be intensified and the clearness of the lines. Asser of Amsterdam was the first to put photo-lithography to practical use, but probably it is to Osborne of Melbourne that we are indebted for the modifications which made it the process now employed by every map-maker in the world. A sheet of suitable paper is coated by floating on a solution of bichromated gelatine or albumen; printed under a negative and inked either by a roller or, better still, by spreading the ink evenly and passing the paper through the press once or twice as if drawing a proof. The inked sheet is then laid face down on warm water if gelatine has been employed and cold if albumen. The gelatine, where light has not affected it, swells and dissolves, leaving ink only where light has acted, the parts representing the dark lines of the original. A spray with water or even a slight wash with a sponge makes it ready, after drying, for transferring to the stone or plate and the quality of the work will depend on the care given to the preparation of the transfer.

Photo-lithography is the principle used in offset printing. See OFFSET-PRESS under PRINTING PRESSES; also PHOTO-ENGRAVING.

PHOTOMETER, an instrument intended to indicate relative quantities of light, as in a cloudy or bright day, or to enable two light-giving bodies to be compared. A photometer in common use was invented by Bunsen; it consists of a screen of thin paper moistened with a solution of spermaceti in turpentine, except a spot in the centre. This screen being placed on a stand at a fixed distance from a source of light of constant intensity, the ungreased spot appears darker than the greased part. One of the lights to be compared is then placed in front of the screen and adjusted at a distance such that the ungreased spot is illuminated as much as the rest of the screen. A similar experiment being made with the other light to be compared, the intensities of the two are to one another in the proportion of the squares of the distances from the screen at which the lights must be placed in order to cause the disappearance of the ungreased spot. Other photometers depend upon sensitizing a paper which is darkened by exposure; and in variations in the resistance of a selenium cell. The art of measuring the intensity of a source of light is termed photometry.

PHOTOMETRY is the art of comparing the intensity of a source of light with that of another source which is taken as a standard. The possibility of making such comparisons depends upon the power of determining by means of the eye when two neighboring fields of view, illuminated respectively by the two sources in question, are equally bright. The sensitiveness of the eye to inequalities of brightness does not greatly exceed 1 per cent, even under the best conditions; and since it frequently falls below that value from fatigue and from various other causes, numerous attempts have been made to find photometric methods which are independent of this organ, but thus far without much success.

Photometers.—Any instrument for the measurement of the intensity of a source of light is termed photometer. Since all attempts to substitute for the eye such instruments as the thermobile, the bolometer and the selenium cell have, for the ordinary purposes of photometry, led to unsatisfactory results, all existing photometers which have come into general use are based upon the above-mentioned power of the eye. The earliest form, which was originally described by Bouguer, was invented early in the 18th century. It consisted of a screen *AB* (Fig. 1), illuminated by the sources of light *S* and *s*, the intensities of which were to be compared. The partition *PC* prevented the light of *S* from falling upon *BC* and that of *s* from reaching *AC*. The distance of the two sources from the screen was adjusted until the illumination of *AC* appeared to the eye to be equal to that of *BC*.

Since the illumination produced by a source of light is inversely as the square of its distance:

$$b_1 = Const.\frac{I_1}{d_1^2}$$

$$b_2 = \text{Const.}\frac{I_2}{d_2^2}$$

where d_1 and d_2 are the distances of *S* and *s*, respectively, from the screen, b_1 and b_2 the illumination of the screen due to *S* and *s* respectively and I_1 and I_2 the intensities of the screens. Since $b_1 = b_2$ we have

$$\frac{I_1}{I_2} = \frac{d_1^2}{d_2^2}$$

An ingenious modification of this instrument, devised by Lambert (1760) and subsequently used by Rumford (1794) is known as the

Shadow Photometer or Rumford Photometer.—In this apparatus an opaque body, usually an upright rod (*R*, Fig. 2) is placed in front of the screen. The surface of the screen is illuminated by both sources but the two shadows *AB*, *CD*, are each illuminated by light from one of the sources exclusively. When these shadows are equally bright the distances of *S* and *s* from the shadows which they illuminate determine the relative intensity of the two sources.

Ritchie (1826) introduced a new principle into photometry. He placed the two lights to be compared at the ends of a track or bar along which a box containing two mirrors *M*,*M'* (Fig. 3) could be moved, until the rays from *S*, reflected at *M* to the left half of the screen *AB* gave an illumination equal to that from the rays from *s* reflected by *M'* to the other half of the screen. This screen was of some translucent material, usually paper.

Bunsen (1841) substituted for the Ritchie screen a sheet of unsized paper the central, usually circular, portion of which had been rendered translucent by the application of oil or of melted paraffin. The paper when placed between two sources of light, the plane of the paper perpendicular to the incident rays on either side, affords a very simple and convenient means of determining when the illumination from the two sides is equal. When subjected to unequal illumination from the two sides the translucent portion of the face toward the brighter source appears dark, the unoiled portion bright. On the other face the reverse is true (see Fig. 4). As the paper is moved away from the brighter source and toward the weaker an interchange in the appearance of the two surfaces occurs and there is a neutral position in which both appear alike and in which it is scarcely possible to distinguish the translucent portions. When this position has been found the relative intensities of the two sources may be calculated from the law of inverse squares. To facilitate the observations the bar or track upon which the paper screen is mounted is divided into a convenient number of equal parts.

The sheet of paraffined paper, technically known as the Bunsen disc, is usually mounted in a wooden box with blackened walls (the photometer carriage), which slides or rolls along the track between the sources of light. Two small mirrors (*M* and *M'*, Fig. 5), mounted obliquely within the box, enable the operator to observe simultaneously the two faces of the paper (*O.O.*).

In practice the paper is frequently used with an unoiled central disc, the remainder of the surface being rendered translucent by treatment with oil or paraffin. To avoid the use of oil or paraffin which gives a surface which soon becomes soiled from dust in the air, two similar paper screens are sometimes employed. Identical portions, in form either a disc or a star, are cut out from the centre of each. A sheet of tissue paper placed between the two then affords a translucent region which takes the place of the oiled paper of Bunsen's original device.

The various forms of photometer already described and all others which depend upon the power of the eye to detect slight inequalities of illumination are essentially of equal sensitiveness. They are all limited by the sensitiveness of the eye and approach the maximum degree of delicacy as we fulfil more and more nearly the conditions under which the eye can be used to the best advantage. All forms of the Ritchie and Bunsen photometers, of each of which many modifications have been devised, are, however, subject to a peculiar source of error. It is found that when two sources of light, the relative intensities of which are known, are compared by means of such photometers, observers will persistently set the instrument to a false position. The majority of observers find apparent equality at a position toward the left-hand source. The errors which are constant for a given observer, however great his experience, range from 1 per cent to 10 per cent. They appear to be analogous to the errors which occur when one endeavors to bisect a straight line by the eye without the use of instruments. The existence of this personal error has led to the substitution, whenever extreme precision is desired, of a form of photometer in which only one eye is used and in which the conditions of maximum delicacy are more completely met than in any of the earlier types of instrument.

The photometer in question was invented by Lummer and Brodhun. In this photometer as in the instruments of the Ritchie and Bunsen types, the two sources of light to be compared are mounted at the end of a graduated bar or track. Upon this runs the photometer carriage, the essential features of which are as follows:

1. An opaque screen (*O. O*, Fig. 6) upon the whitened faces of which the light from the two sources shines; each face of the screen being illuminated exclusively from one of the sources of light.

2. The device by which both faces of the screen can be observed simultaneously without the use of both eyes. This consists of two precisely similar mirrors *M, M'*, mounted facing each other within a dark box not shown in the diagram. The diffusely reflected rays from the screen reach these mirrors at an angle of 45° and are reflected as shown in the figure. Where the reflected rays cross each other at an angle of 90 degrees, is placed an ingenious arrangement technically known as the Lummer-Brodhun *body*, (*BDEF*) which consists of two right-angled reflection prisms placed with oblique faces together so as to form a cube. The face of one of them is, however, cut away so that contact occurs only over a small circular space in the middle of the face. Light from the source *S* (Fig. 6) diffusely reflected from the left-hand face of the screen and received upon the mirror *M*, enters the *body* through the face *AB*. Those portions of the beam which reach the central face of contact pass through uninterrupted, while all other portions are intercepted by total reflection within the prism. Light from *s*, diffusely reflected from the right-hand face of the screen, is reflected by the mirror *M'* to the face *DE* of the *body*. Those portions which fall upon the central area of contact pass through, but the surrounding portions are totally reflected and leave the *body* in paths parallel to and surrounding the path of the transmitted beam which has come through the face of contact from the mirror *M*. Observations are made by means of a small telescope *T*, the field of view of which consists of a disc of light coming from *S*, surrounded by a ring of light from *s*. If the illumination of the side of the screen facing *s* be brighter than that upon the opposite face of the screen, which receives its light from *S*, one sees a bright disc of light surrounded by a dark ring. When the position of the photometer carriage upon which the screen, mirrors, body and telescope are mounted is moved to a position such that the two sides of the screen are equally illuminated, disc and ring are equally bright. The distances from the two sources are then read upon the scale of the photometer bar and the relative intensities of the sources are computed. The accuracy of this form of photometer depends upon the following conditions: (1) The opaque screen must stand in the line joining the two sources of light. (2) Its two faces must be identical in character both as regards color and power or diffuse reflection. (3) The mirrors *M* and *M'* must be identical as regards reflecting power and must be symmetrically placed. (4) The Lummer-Brodhun body must be optically perfect so that transmission through the faces of contact will be complete.

The construction of the instrument is such as to permit reversal by revolving the whole apparatus upon a horizontal axis through 180 degrees. The face of the screen which previously was lighted from the source *S* by means of the mirror *M* and the prism *ABG* now receives its light from *s* and vice versa. Any lack of uniformity in the two sides of the apparatus is thus readily detected and can be eliminated.

Standards of Light.— When, owing to the development of the gas industry, the art of photometry began to take on commercial importance, it became necessary to have recognized standards of comparison. The standard adopted in France was a vegetable oil lamp with mechanical draft burning colza-oil and known from its inventor as the *Carcel lamp*. The dimensions of the lamp were carefully specified together with the form and size of the chimney and the amount of oil (42 grams an hour) to be consumed.

In England the light unit adopted by gas manufacturers and subsequently legalized by the board of trade was the light given by a candle. The British standard candle was made of spermaceti. It was slightly conical in shape for convenience in molding and of such size ($\frac{9}{10}$ inch in diameter at the bottom, 10 inches long and $\frac{8}{10}$ inch in diameter at the top) as to consume 120 grains of wax per hour. The wicks were made of three strands of cotton, each strand consisting of 18 strands.

In Germany the manufacturers of illuminating gas adopted as their standard a candle of paraffin. This candle, which is known as *Vereinskerze* had a diameter of 22 millimeters. The wick consisted of 25 strands of cotton. The height of the flame when burning normally was 50 millimeters. In Munich the legalized standard agreed upon between the city and the gas company was the light from a stearine candle slightly conical in form, of a mean diameter of 20.5 millimeters, the height of the flame being 56 millimeters.

The practical advantage of the candle as a light unit, which consists in the fact that it is a form of light with which the public is familiar, led to the introduction in France of a standard candle known as *la bougie de l'étoile*. This was a stearine candle consuming 10 grams an hour. Its light was approximately equal to $\frac{1}{7}$ of a carcel. The height of the flame was 52.5 millimeters.

Extended studies of the performance of standard candles and countless attempts to determine the relative intensities of the various forms legalized in the different countries have only served to demonstrate the inadequacy of this source of light even when prepared with the utmost care, to serve as a standard in photometry. Almost the only advantage such a unit possesses is found in the fact that the term *candle-power* has a familiar sound to the public.

The range and character of the fluctuations of the British standard candle may be seen from the curve in Fig. 7 which is taken from measurements made by Sharp and Turnbull ('Transactions of the American Institute of Electrical Engineers,' Vol. 13, pages 145, 1896). The curve covers a period of 60 minutes during which the brightness of the candle was observed at intervals of 30 seconds. It will be seen that the intensity of the flame is subject to frequent fluctuations often amounting to more than 10 per cent.

The altogether unsatisfactory performance of the various forms of standard candle has led to numerous attempts on the part of photometrists to find a more reliable standard of light. A form of standard lamp introduced by Methven (1878) and consisting of an Argand burner for ordinary illuminating gas with a metal screen which cuts off all but the central portion of the flame has been extensively used in gas photometry. The tests of this standard have shown, however, that it is subject to variations but little less than those of the candle, owing to the variable character of the gas employed. In 1877 Harcourt introduced a standard lamp in which the petroleum product known as pentane is the fuel employed. This substance which is obtained by fractional distillation cannot be readily obtained in complete purity, but the distillate which boils off at 50° C. consists largely of pentane with a small proportion of other closely allied hydrocarbons. The liquid is highly volatile and in the Harcourt lamp the vapor is ignited at the end of a metal tube extending about two inches above the wick. A modified form of the pentane standard lamp is extensively used in gas photometry in the United States and is said to give excellent results.

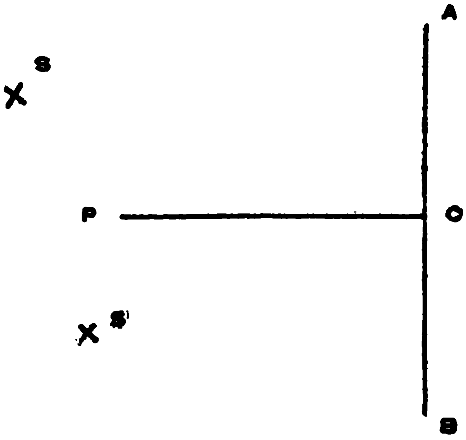

FIG. 1.—Bouguer's Photometer.

If a luminous flame is to be the standard it is essential to find a fuel of known and definite composition and to devise a lamp which will insure its combustion under uniform conditions. Extensive experiments with lamps burning vegetable and animal oils and with a variety of petroleum lamps have only demonstrated the necessity of a proper fuel.

One of the few available fuels of known chemical composition is amyl acetate. A standard lamp in which this liquid is used as the combustible was described by Hefner-Alteneck in 1884 ('Elektrotechnische Zeitschrift,' 1884, page 20). The performance of this lamp was so promising that it was, after thorough and systematic study at the Imperial Physico-Technical Institute in Charlottenburg, reduced to standard form. The modified type of amyl-acetate lamp thus produced has become recognized as the most reliable and desirable form of primary standard thus far proposed.

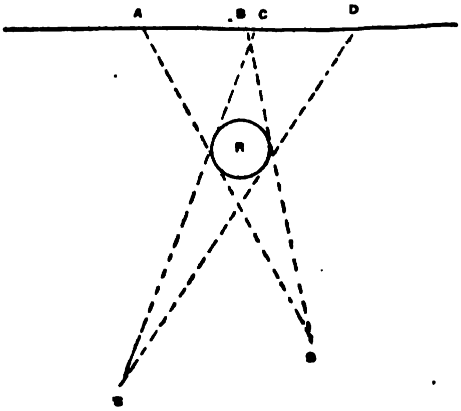

FIG. 2.—The Shadow Photometer.

The Hefner lamp in the final form given it, as the result of the experiments made in Charlottenburg, consists of a cylindrical body of brass upon which is mounted the wick tube. This is a vertical tube of German silver, the height, diameter and thickness of wall of which are accurately specified and the dimensions and details of construction of which must be followed with precision if the intensity of the flame is to agree closely with the standard. Upon the accuracy with which it is possible to follow these specifications, in metal working, the performance of the lamp depends. Lamps which are faithful copies of those upon which the original investigations were carried out give results far more consistent as to intensity of light than have been attained with any other form of standard in which a flame is used, and it is this complete and accurate reproducibility which has caused the Hefner lamp to be adopted as the best available primary standard. The light-giving power of the flame of this lamp, like that of all flames, varies not only with the composition of the combustible but likewise with the height of the flame and with the amount of moisture in the surrounding air. The relation between flame-height and intensity as determined by Liebenthal to whom our knowledge of the performance of the Hefner

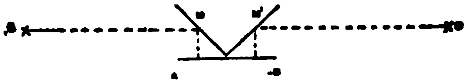

FIG. 3.—The Ritchie Photometer.

lamp is chiefly due, is shown in the following table:

Flame heights	Intensities
20 mm.	0.38
25 mm.	0.55
30 mm.	0.70
35 mm.	0.85
40 mm.	1.00
45 mm.	1.12
50 mm.	1.25
60 mm.	1.50

To determine the height of the flame a gauge, which consists of a lens throwing a magnified image of the tip of the flame upon a disc of ground glass, is mounted with its axis 40 millimeters above the top of the wick-tube as shown in Fig. 8. The character of the wick does not affect appreciably the intensity of the flame.

A precise relation between the intensity of the Hefner unit and the various standard candles cannot, owing to the inconstancy of the latter, be said to exist. Since, however, candlepower is still the term according to which nearly all artificial sources of light are rated it has been found necessary to adopt some definite ratio. The photometrists of the Physico-Technical Institute, using numerous data obtained by various observers, found as a mean value, 1 Vereinskerze = 1.2 Hefners; also 1 British Standard Candle = -1.14 Hefners, or 1 Hefner = .877 British Standard Candles. Schiele from extensive measurements found 1 Hefner = .881 British Standard Candle. It is probable that the factor .88 gives as fair a ratio representing the average performance of the candle as can be obtained.

Another substance of definite composition the flame from which would be a very desirable standard of light is acetylene. The advantage of such a flame over that of the amyl-acetate lamp, the ruddy color of which makes comparisons with the brilliant sources of light used in modern illumination uncertain, lies in the fact of its far greater intensity and whiteness. Unfortunately acetylene on account of its richness in carbon will burn without smoking only when mixed, before escaping from the burner, with a considerable amount of air. In all practicable forms of acetylene burners thus far devised the openings for the egress of the gas are very small. It is on this account difficult to produce burners all of which will give precisely the same candle-power. Owing likewise to the minuteness of these apertures the burner is subject to partial choking by small particles of lime, etc., deposited from the gas. Thus the amount of gas flowing under a given pressure is reduced and what is quite as serious, the proportions of the mixture of acetylene and air upon which both the brightness and the color of the flame depend is changed. Because of the difficulty of burning acetylene under completely controllable conditions, there is at the present day no standard burner for use in photometry, but as a secondary standard, subject to repeated comparison with some reliable primary source, the acetylene flame has been found to be of great value.

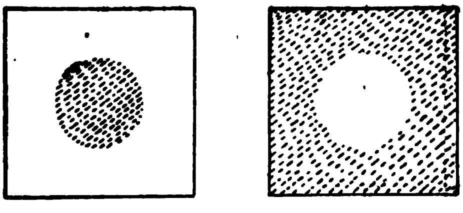

FIG. 4.—The Bunsen Disc.

Incandescent solids maintained at a constant temperature by the action of the electric current would seem to offer possibilities for the construction of a light standard free from the objections to which all standard flames are necessarily open. Numerous attempts to produce light standards based upon this principle have been made; the most noticeable being that of Violle. Violle's device consisted of a mass of platinum brought to its melting point by the action of the current. He proposed to define as the standard the light from a square centimeter of the surface of the metal at the temperature of solidification. The advantages of a standard capable of such rigorous definition was so obvious that the electrical congress assembled at Paris in 1881 appointed a committee to determine the question of its practicability. Extended experiments at their hands and on the part of the members of the Imperial-Technical Institute in Charlottenburg have unfortunately led to the conclusion that the platinum standard cannot, with the means ordinarily at command, be made to give constant results.

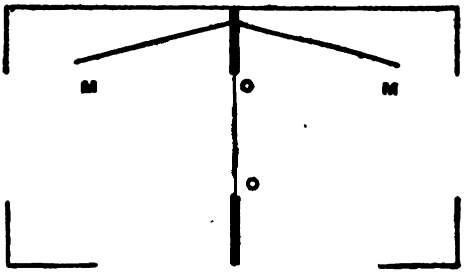

FIG. 5.—Mirrors and screen of Bunsen Photometer.

In the meantime studies of the performance of the ordinary incandescent lamp have shown that we have in it, when properly prepared and handled, a source of light better adapted as a working standard than any other at present available. The carbon filament heated in vacuo by means of a constant current is subject to changes of illumination only as the result of the slow disintegration of the carbon or of gradual loss of vacuum in the bulb surrounding the filament. By the use of storage batteries supplemented by the regulation of a resistance in the circuit it is possible to maintain the filament of an incandescent lamp in a state of incandescence, the constancy of which leaves little to be desired. Given one such lamp, the intensity of which is known or is arbitrarily taken as the unit, it is possible to determine the voltage at which other lamps have the same intensity, so that it is possible to make copies of the original which, whenever subjected to current at the proper voltage, will return to the intensity at which they were when the comparison was made. Thus while it is not possible to construct incandescent lamps which shall at a prescribed voltage give a definite illumination, it is on the other hand possible by comparison of such lamps with a given standard to find the various voltages at which they will have equal intensities.

The use of the incandescent lamp does not fully solve the problem of the standardizing of light sources; for the determination of the lamp from which the copies are to be made must be by reference to some primary standard such as the Hefner lamp. Having once adjusted one incandescent lamp to agreement with the standard, however, one may make copies of these which will agree with one another much more closely than any two Hefner lamps or than a single Hefner lamp upon successive trials will agree with itself. If one were to start anew, with the Hefner lamp as a standard, and make another set of standardized incandescent lamps, these, though highly uniform, might show no better agreement with the former set than that which one can obtain in subsequent trials with the lamp itself. Such variations of the Hefner lamp amount to about 2 per cent.

The province of the art of photometry does not end with the determination of the intensity of the light sent out in a given direction from any source. One of its chief purposes is to enable us to deal definitely and intelligently with the problems of illumination and these are complicated by the fact that, in general, sources of light do not radiate with equal intensity in all directions. The accepted unit of illumination among photometricians on the continent of Europe is the *lux*, which is the illumination received from a source of unit intensity at a distance of one metre. The unit source in this definition is the Hefner lamp already described, so placed that the light is received from it in the horizontal plane. The term *bougie-metre* is also used in speaking of this unit of illumination. The term *bougie* (or candle) in this definition is not any of the standard candles already described but a hypothetical candle equal to the Hefner. In countries where British measures are still in vogue a unit of illumination frequently employed is the *candle-foot* which is the illumination afforded by a British standard candle placed at a distance of one foot from the illuminated surface.

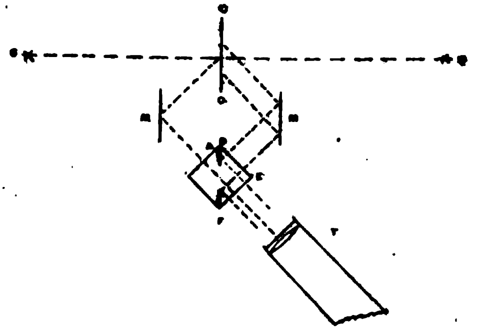

FIG. 6.—Diagram of the Lummer-Brodhun Photometer.

The distribution of light from the various sources used in artificial lighting is far from uniform and it is necessary, therefore, in order to give a complete description of the lighting power of any source, to determine the intensity of the source as viewed from all possible directions. In the case of certain sources of light such as the incandescent electric lamp this is easily accomplished by mounting the lamp at the end of the photometer bar in a holder so constructed as to permit of rotation about both a vertical and a horizontal axis without displacing the centre of the lamp from its position. In the case of other sources, such as the arc lamp and most flames, which cannot be tipped from the vertical without modifying the distribution of light or interfering with the performance of the lamp, it is necessary to have recourse to a mirror, placed in the axis of the photometer bar, by means of which light can be reflected along the bar. By varying the angle of the mirror the light can thus be viewed from any desired direction. Corrections must of course be made for loss of light at the surface of the mirror.

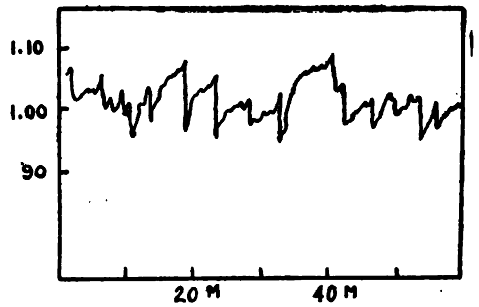

FIG. 7.—Fluctuations of a British Candle.

The results of the exploration of the field of light around a given source are usually expressed by means of curves. The curve showing the distribution in a horizontal plane is called the curve of horizontal intensities. The corresponding curve for any vertical plane is a curve of vertical intensities. In Fig. 9 are given two typical curves of vertical intensities from measurements of an open-arc lamp without shade. Fig. 10 is a diagram showing the illumination of the ground at different angles when such a lamp is used in street lighting. When the curve of horizontal intensities is a circle, a single curve of vertical intensities suffices to completely describe the performance of the source of light; when, however, as is usually the case, the curve

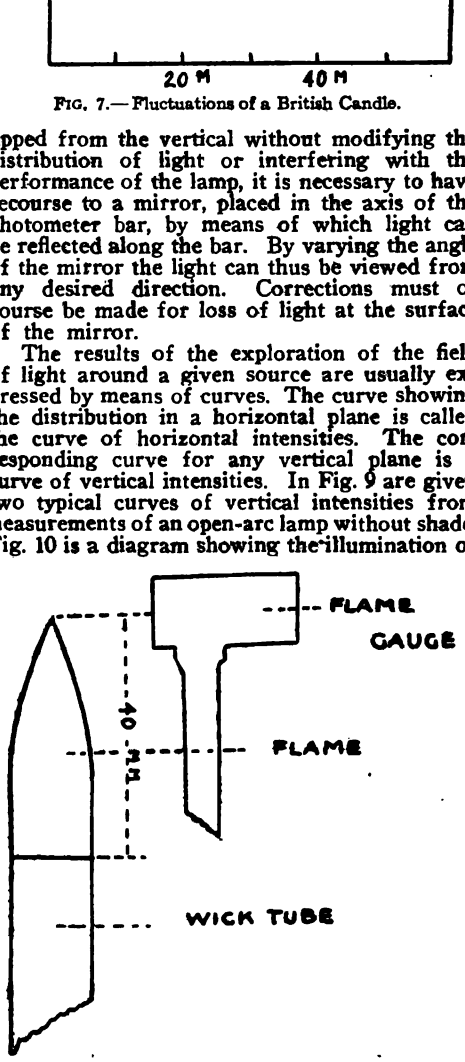

FIG. 8.—Wick tube, flame and gauge of the Hefner Lamp.

of horizontal intensities is not a circle, the curve of vertical intensities will vary in form as the vertical plane to which the curve applies is revolved about a vertical axis through the centre of the source of light. The average intensity of a source of light viewed in the horizontal plane is called the ***mean horizontal intensity.*** The average intensity, taking into consideration every possible point of view, is called the ***mean spherical intensity*** of the source.

The rigorous determination of either of these quantities in the case of unsymmetrical sources would take an infinite number of readings. In the case of the incandescent lamp, which will permit of such treatment, it is, however, possible to obtain the mean horizontal intensity by rotating the lamp upon its vertical axis at the end of the photometer bar. Measurements made upon the lamp revolving thus at a speed of several revolutions per second are found to agree well with the mean horizontal intensity as determined by plotting a series of readings taken from different positions at a horizontal plane with the lamp at rest, and integrating the curve thus obtained. The approximate determination of mean spherical intensities of non-symmetrical sources such as the arc lamp, when made with the ordinary photometer and mirror, involves the taking of many individual readings. In the Franklin Institute tests, made at the Electrical Exhibition in Philadelphia in 1885, 65 measurements were made in each determination and these were combined in computing the main spherical intensity. These readings were made from 38 directions distributed as evenly as possible around a sphere of which the light was the centre. To avoid this laborious process numerous special forms of photometer have been devised of which the most successful is that invented by Matthews and used in the extensive studies of the arc light recently carried on under the auspices of the National Electric Light Association. In this instrument which is known as Matthews' ***integrating photometer*** 24 large mirrors are arranged around the source, the mean spherical intensity of which is to be determined, in such a way as to produce upon the photometer screen an illumination proportional to the mean spherical intensity. The adjustment of these mirrors is such as to direct simultaneously toward the photometer the beams of light which the eye of an observer would receive if he were to view the source successively at angular intervals of 15 degrees in a vertical plane. The intensity of the light received in these various directions must further be reduced in the ratio of the sine of the angle between the direction of view and the vertical, and this is done by the interposition of glasses which are smoked until they transmit the desired proportion of the light falling upon them. With this instrument the photometer gives by a single reading a value proportional to the mean spherical intensity of the source.

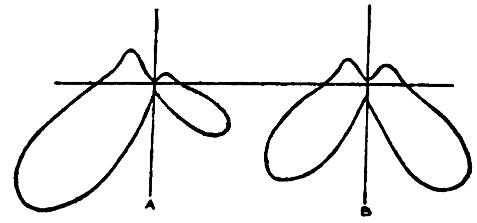

FIG. 9.—Curves of vertical intensities (open-arc lamp).

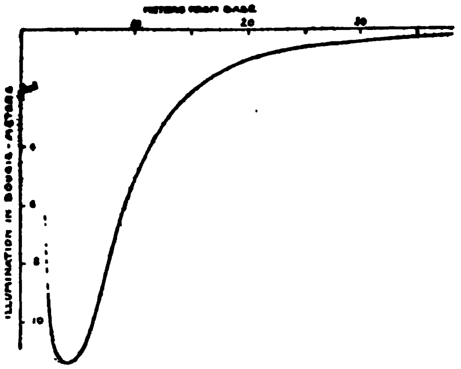

FIG 10.—Illumination from an open-arc street lamp.

For the application of photometry to astronomy, see STARS. For the application of the Selenium cell of photometry, see SELENIUM.

Bibliography.— Palaz, 'La Photometrie Industrielle' (translation by Patterson); Stine, 'Photometrical Measurements'; Bell, 'The Art of Illumination.' Consult also the reports of the committee on photometry in the 'Proceedings' of the National Electric Light Association; various papers in the 'Transactions' of the American Institute of Electrical Engineers, in 'La Lumière Electrique,' in the 'Elektrotechnische Zeitschrift,' and in *Schilling's Journal für Gas- und Wasserversorgung.*

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PHOTOMICROGRAPH. A photomicrograph is a photograph of a microscopically small object. The term microphotograph is sometimes used, but is very inaccurate, and should be used only to designate a very small photograph; e.g., a photograph an eighth of an inch square of the Niagara Falls is a microphotograph. Simple photomicrographs may be made without any expensive special apparatus. A microscope and any camera with a ground glass for focusing will suffice. The lens, or lenses, but not the shutter, are removed from the camera; the eyepiece is removed from the microscope, which is placed in a horizontal position. The eyepiece end of the microscope tube is now inserted a little into the lens barrel of the camera and a black cloth is wound around the place where they come together in order to exclude the light. The tube of the microscope should be exactly perpendicular to the ground glass of the camera. Any strong light may be used, as direct sunlight, a gas mantle lamp, an acetylene lamp, a kerosene lamp, or an electric arc; but ordinary incandescent bulbs are not satisfactory. Remove the mirror of the microscope, since it will not be needed in any photomicrographic work, and let the light come directly into the optical axis of the microscope. If the illumination of the ground glass is uneven and shows a "flare spot," look at the inside of the tube of the microscope. Probably it was not blackened. Put a black paper inside the tube. Modern microscopes are well blackened inside. Move the light back and forth and sidewise until the best illumination is secured. About six inches from the stage is likely to be a good position.

Suppose we are to photograph a transverse section of a vascular bundle, using a two-third-inch (16-millimeter) objective. With such a low power lens and with all lenses of longer focus, the condenser in the microscope is not only unnecessary but it interferes with good work. Remove it. However, the condenser should be used with objective of one-third inch (eight millimeters) focus and with all objectives of shorter focus. Carefully focus the object upon the ground glass. The ground side of the glass should be next to the microscope. After a sharp focus has been obtained, close the shutter of the camera and insert a plate, just as in ordinary photography. The time of exposure will depend upon the intensity of the light, the speed of the plate and the magnification. Small negatives may be made from lantern slide plates, especially when a contrasty negative is desired. With a gas mantle lamp, a lantern slide plate and a 16-millimeter objective used without an ocular or condenser, try an exposure of 30 seconds. Until one becomes proficient in estimating exposures, it is a good plan to expose 10 seconds; then close the shutter and push in the slide of the plate holder just an inch; then expose 10 seconds, close the shutter and push in the slide another inch; then repeat twice more and you will have exposures of 10, 20, 30 and 40 seconds on one plate. It is easy to determine which is the best exposure and only one plate is sacrificed. A print on printing-out paper from such a negative is very instructive, since it shows the comparative merits of negatives of various densities. A filter, such as is used in out-of-door photography, is likely to improve the negative. Experts use filters of various colors, according to objects and the features which are to be emphasized. The developing is the same as in case of lantern slides (q.v.), or as in case of ordinary photography, if a fast or medium plate is used. With higher powers, use the condenser and, if necessary, the ocular. If much work is to be done, the need for a solid support for both camera and microscope will be realized. A simple contrivance which any one can make for himself is illustrated in Fig. 1.

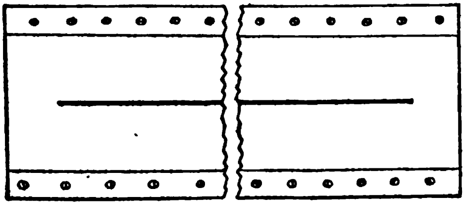

FIG. 1.

Use a clear board an inch thick, a foot wide and five feet long. On top of the board, at the sides, screw two strips, an inch thick, one and one-half inches wide and five feet long, so as to form a guideway for the camera. A long slit, one-quarter inch wide, should be made to accommodate the screw which is ordinarily used to fasten the camera to a tripod. If the same camera is to be used for all work, the space between the two long strips should be just wide enough to admit the camera. A strip of wood one-half inch thick, an inch wide and five inches long, placed over the horse-shoe base of the microscope and held in place by a bolt put through the long slit, will hold the microscope in position.

For the finest class of work, especially where very high magnifications are desired, elaborate and expensive apparatus is very convenient. In these elaborate forms, experts do not always use the same arrangement. The relative positions of the various parts, as shown in Fig. 2, is very effective.

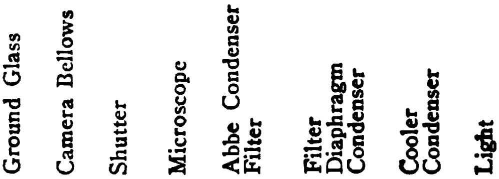

FIG. 2.—Relative positions of the various points.

Consult Chamberlain, C. J., 'Methods in Plant Histology'; Walmsley, W. H., 'The A. B. C. of Photomicrography'; Wratten, 'Photomicrography' (Eastman Kodak Co.).

CHARLES J. CHAMBERLAIN.

PHOTOPHONE, the name given an apparatus for transmitting articulate speech to a distance along a beam of light. It was first described in 1880 by Alexander Graham Bell, known in connection with the telephone, at the Boston meeting of the American Association; but already in 1878 its inventor had announced the possibility of "hearing a shadow" by means of a similar agency. It has never been commercially introduced. The success of the photophone depends on the peculiarities of the metal selenium. Crystalline selenium offers a high degree of resistance to the passage of an electric current; it is eminently sensitive to light; and the resistance is less when exposed to light than in the dark, being in some cases only a 15th in the light of what it is in the dark. Professor Bell, his friends and assistants devised some 50 forms of apparatus, for so varying the transmission of light to prepared selenium as to produce audible sound. In the photophone found most serviceable the transmitter is a plane mirror of silvered microscope glass or thin mica; the receiver, fixed at a distance without any connection, is a parabolic reflecting mirror, in the focus of which is placed a sensitive selenium "cell," connected in local circuit with a battery and telephone. When the apparatus is used, a strong beam of light is concentrated by a lens in the plane mirror; the speaker directs his voice against the back of this mirror, which is thrown into vibrations corresponding with those of the voice. The reflected beam of light, to which corresponding vibrations are also communicated, is directed through a lens to the receiving mirror, and creates in the selenium cell a rapidly variable current, which at the end of the telephone attached becomes audible again as vocal sound. When first described, the photophone had been used effectively with a distance of 230 yards between transmitter and receiver. The rays of the oxyhydrogen light, or of an ordinary kerosene lamp, suffice for transmitting articulate speech. The loudest sounds obtained from the photophone were produced by means of a perforated disc, noiselessly revolving so as rapidly to interrupt the light in transmission. It was also found that a very audible sound could be procured from the selenium without the aid of telephone and battery. A beam of intermittent light will produce a strong musical note from the selenium. Further experiment showed that selenium is not the only substance thus sensitive to light. Still louder sounds than these obtained from the selenium directly, though not articulate, were got from diaphragms of hard india-rubber and of antimony; and sounds of varying intensity were given out by many other substances, including gold, silver, platinum, copper, zinc, lead, paper, parchment and wood. Consult Bell, 'The Photophone' (1878). See SELENIUM.

PHOTOPLAY, the technical name given to a moving-picture which presents a complete drama. The conditions under which a moving-picture is made and exhibited place the photoplay in a distinct class by itself. It cannot, like the novel, short story, or the regular theatrical play depend upon language to explain situations or to express thoughts and emotions. Its sole medium of expression is self-explanatory action. The photoplay differs from other moving-pictures in that it has a definite plot, which is worked out by a series of dramatic scenes. There is no limit to the number of these separate scenes; they may run up to 40 or 50, if necessary to round out the story. Nor are there any bounds within which the plot action shall move forward. The ability to join into one picture films made at the opposite ends of the earth, if desired, give the widest latitude to the inventive faculties of the author. In these peculiarities the photoplay leans more toward the plan of the novel than to the theatre play presented in three or four acts, and within the confines of the stage. The scenes in which the photoplay is presented are not required to progress consecutively as to time of happening: it is entirely permissible for the action to «cut back» as in the novel, to take up a parallel sequence of events needed to bring the action to a climax.

The elimination of the spoken language normal to the stage play and such a large auxiliary in the development of the story in the novel, necessarily shortens the time required to present a photoplay covering the same recital. Thus a play which would consume perhaps three hours on the stage, stripped to its physical action only may be shown as a photoplay in the course of 20 minutes. One of the results of this condensation is to give the photoplay a peculiar hurried effect. There is entire absence of repose, so indispensable in a stage play or novel as a foil to even the minor action. The consequence of these limitations is to place the photoplay on so high a plane of intensity that all action is exaggerated far beyond the normal. This apparent haste in the action is enhanced by the characteristic focal expression of the photographic lens, with its distorted perspective — distorted as compared with the elastic vision of the human eye. The difficulties for both author and audience are mutually recognized, and certain auxiliary devices for helping the presentation along are accepted as conventional. The use of some language is permissible in the line of subtitles, leaders or captions, as they are variously called. When skilfully composed they not only introduce the scene about to come on the screen, but link it with the action of the scene just halted. «Inserts» are bits of language of a different sort, arranged as a part of the plot action — as, for instance, the display on the screen of a letter, telegram, or scrap of newspaper, that the spectators may read, each for himself. These adjuncts however, are to be avoided, and wherever possible substituted by action which will suggest, if not actually depict, the progress of the plot.

The conventional measure of length of a photoplay is the «reel.» This is a strip of film 1,000 feet long, and requiring about 20 minutes for its display on the screen. A photoplay may be a one-reel play, or two-reel play, or longer; or it may be less than one reel, in which case it is termed a «split-reel.» Photoplay writers usually endeavor to adapt their productions to these conventional limits without unduly expanding, or «padding» the manuscript of the play, or, on the other hand, skimping the scenes, leaders, inserts, etc., so that the plot is not clearly worked out. In the one-reel photoplay there should be about 20 scenes, averaging one minute each upon the screen; and five or six leaders and inserts combined for this length of film is regarded as very good work.

The production of a photoplay requires the perfect collaboration of several highly skilled specialists. The author devises his plot and to a large degree the scenes which shall express it. His manuscript is submitted to the photoplay editor, who passes on the availability of the story for photoplay presentation. He may reject it altogether, return it to the writer with suggestions for amendment, or, if the subject appeals to him as worthy, may make the emendations himself. In the larger establishments the editor has a corps of readers to assist him in winnowing the great mass of manuscripts submitted by would-be photoplaywrights. For every manuscript accepted more than 700 are rejected as unsuitable. The accepted photoplay goes to the director of the establishment. His is perhaps the most vital part of all, as it is his task to make real what the author and editor have imagined. He decides upon the make-up of the scenes, what scenery is to be used, or perhaps made especially, what setting, the actors who are to take part, the clothes they are to wear, their appearances and positions on the stage, the conduct of rehearsals, and the ultimate direction of the actual production of the play before the camera. The camera man's work is largely mechanical, but calls for extreme accuracy. The exposure being made, the film goes to the developing room where the negative made in the camera is developed, and a positive such as is used for projection upon the screen is printed from it. Then comes the «try-out,» when the complete film is exhibited on a screen for the judgment of an exceedingly critical jury, made up of the editor, the director, the actors, the camera men, and every one else who has had a responsible part in the production. Some of the scenes may prove to be inadequate, and may have to be done over again — or possibly omitted altogether. Perhaps the whole play will be rejected as not up to the standard of the firm which must stand sponsor for it in the film market. The editor and director then decide as to the inserts actually needed to give the utmost finish to the play, and these are made by the photographic staff, put into their proper places in the negative, and the whole cemented into one continuous strip. When this is finally satisfactory, many copies are made and distributed by the business department of the producing company to the exhibiting houses all over the country, and in foreign lands as well. So that no one locality may have an advantage over another in point of time on any given picture-play, it is customary for the manufacturer to place a «release date» on the film, before which time it may not be shown.

The studios of the larger photoplay companies are marvels of scientific adaptations of means to end. Some of them are enclosed with glass and the scenes photographed in daylight. Others are fitted with electric lights of great power, which can be grouped for any desired effect of lighting. For small scenes the actual space within which the play is enacted may not be more than 8 or 10 feet wide and about 6 feet in depth. In a large studio, 50 to 60 feet long, it is not uncommon to have three or four scenes in action at one time, each attended by its own director and camera man.

In these establishments a permanent company of actors is in constant attendance, and each studio has its list of special actors who can be called on at any time for special service. A staff of artists and mechanics — carpenters, masons, smiths and scene painters, is also a permanent part of the personnel; the preparation of the scenery for a single 20-minute play occupying the time of several men perhaps for three or four weeks. In the property room of such a studio is gathered a collection of the oddest description, ranging from the primitive bow and arrow of the aboriginal Indian to a modern quick-firer; from the New England wheelbarrow to an oldtime «prairie schooner»; the dobe hut of the Mexican, and the rose-covered porch of an old Virginia mansion — anything and everything which may add impressive reality to the detail of any possible story. In the costume room are literally thousands of garments of every age and nationality. Some studios, in addition to all these, support extensive stables to provide horses of certain required training, beside cattle and other lesser livestock called for by the play approved by the editor.

Mention has been made of the very large proportion of photoplay manuscripts rejected by readers and editors as compared with the very few accepted. Scores of books have been published to aid those who have the ambition to write photoplays, but beside the mastery of the technique of expression peculiar to the photoplay, a genuine gift for story-telling is a sine qua non of the successful writer's equipment. The great difficulty of getting really good plays which are new as well as effective on the screen has led the large film companies to employ a regular staff of skilled writers to produce the bulk of the plays eventually exhibited, the small supply received from the outside public being undependable when compared with the constant and importunate demand of the trade — amounting to an aggregate of 5,000 to 6,000 new plays annually. The literature of all countries is searched by staffs of translators for plots which, though not new, may be at least made to appear so by presenting them in varied settings. This matter of changing the setting of an original story has developed business enterprises of great complexity. Some of the larger photoplay makers have traveling companies of actors who wander about the earth enacting the scenes of plays to which they are assigned — in the Western Plains, in the jungles of the tropics, among the palms of the West Indies, beside the pyramids of Egypt, in the white snowfields of the Arctic, or within the hallowed precincts of the Holy Land. The same plot worked out in such widely varying environments, with appropriate costumes and with characteristic personnel, will give a whole series of plays hardly to be recognized by the ordinary photoplay audiences as being of even remote relationship.

A more intimate knowledge of the subject will require the concentrated study of the very extensive literature of the photoplay, of which only a few titles may be mentioned in this article. See also MOVING PICTURES, for description of the instruments and processes used in making and exhibiting the films.

Bibliography.— Consult Bernique, J., 'Motion Picture Acting for Professionals and Amateurs' (Chicago 1916); Croy, H., 'How Motion Pictures are Made' (New York 1918); Dimick, H. J., 'Photoplay Making' (Ridgewood, N. J., 1915); Esenwein, J. B. and Leeds, A., 'Writing the Photoplay' (Springfield, Mass., 1913); Freeburg, V. O., 'The Art of Photoplay Making' (New York 1918); Harrison, L. R., 'Screencraft' (New York 1916); Lomas, H. M., 'Picture-Play Photography' (London 1914); Muensterberg, H., 'The Photoplay: A Psychological Study' (New York 1916); Nelson, J. A., 'The Photoplay' (Los Angeles 1913); Phillips, H. A., 'The Photodrama' (Larchmont, N. Y., 1914); Sargent, E. W., 'Technique of the Photoplay' (New York 1916).

PHOTO-SCULPTURE, a novel process used by sculptors for producing statuettes by the aid of photography. It was invented by M. Villème, a French sculptor. The model stands in a studio of special construction, in the centre of a circle of 24 cameras, by all of which he is photographed at the same moment. The 24 negatives are then projected in succession on a screen by means of an optical lantern and the artist goes over the outline of each with the tracer of a pantograph, a cutting tool acting upon a lump of modeling clay, mounted upon a turn-table, being substituted for the usual pencil. After each photograph is gone over, the clay is turned through 15°, and after a complete revolution it is removed and finished by hand.

PHOTOSPHERE, *in astronomy,* the luminous envelope, supposed to consist of incandescent matter, surrounding the sun. See SUN.

PHOTOSYNTHESIS, the synthesis of chemical compounds by the action of light. The broader subject of photochemistry includes all chemical reactions that are induced or maintained by the action of light, whether they result in true synthesis or not; but photosynthesis, in the strict sense, is a constructive process, resulting in the production of substances that are higher in type than the materials from which they are formed, by reason of possessing a more complicated structure or of containing a greater quantity of energy per unit of weight. Photochemical processes occur in inorganic nature and also in the animal world (notably in the retina of the eye); but the most important case of photosynthesis consists in the formation of starch and other related compounds, from carbon dioxide and water, in the green leaves of plants.

Light cannot produce chemical changes unless it is absorbed. This rather evident fact was first distinctly recognized by Grotthus in 1819, and is usually known as «Grotthus' law,» but it was also independently stated by Draper in 1841, and from this circumstance it is sometimes called «Draper's law.» It does not follow, however, that chemical change will result merely because light is absorbed, and substances that show well-defined absorption bands in the spectrum may not be affected by light in the least degree so far as sensible changes in their chemical properties are concerned. Light-energy that is absorbed without producing chemical effects is doubtless transformed into simple heat-energy, which merely causes the absorbing substance to become warmer. In order to produce chemical action the light must apparently excite some special resonant mechanism in the molecule, and certain additional conditions at present unknown must doubtless be fulfilled also in connection with the chemical potentials of the absorbing substance and the other substances that might conceivably be produced from it. Light is an exceedingly rapid periodic disturbance of the ether that fills space and penetrates between the ultimate particles of which matter is composed; and when a substance undergoes chemical modification in consequence of being subjected to the action of light, it is probable that some part of the molecular mechanism of the substance has a vibration period equal to that of the light that produces the change. When bodies or systems that are large enough to be dealt with individually and which are capable of vibrating or oscillating in certain definite periods are subjected to a disturbance of external origin having this same periodicity, we know that their motions may undergo marked and important changes, and we can hardly doubt that the same thing is true of the molecular systems. A homely illustration of the absorption of vibratory energy in this way may be had by singing a loud note into a piano. Certain of the strings of the instrument — namely, those that are capable of vibrating with the same frequency as the air waves constituting the tone that is sung — are set in motion, and if the singing is abruptly stopped these particular strings give out a faint sound of the same pitch, thereby proving that they have absorbed vibratory energy from the air. When light penetrates a substance that is capable of having photochemical changes induced in it, energy is absorbed by the molecules or atoms of the substance in a presumably similar way, and it is this absorbed energy that brings about the change. This much appears fairly evident, though we do not know the precise mechanism by which the result is accomplished. In some cases in which an effect of this kind occurs the molecules may be merely shaken apart, with the consequent formation of new compounds of a simpler nature; and when this occurs the disruption may be attended by the liberation of energy, so that the final products contain less energy, on the whole, than the parent substance from which they were produced. Other compounds, more stably constituted or more efficiently absorptive, may be able to store up the vibratory energy of the light until they become capable of entering into combinations of a higher type, and in a case of this kind we should have a true photosynthesis.

Inasmuch as light must be absorbed in order to give rise to photochemical action, we find that such action is characterized by high absorption power on the part of the substance that undergoes the chemical transformation. If all the incident light were absorbed the substance would reflect nothing and would, therefore, appear black. If the absorption were only partial and if it took place in such a way that the absorbed energy constituted the same fraction of the incident white light at every wave-length, then the reflected light would contain all the colors that exist in sunlight and in the same proportion in which these colors must be present to produce the sensation of whiteness; and hence in this case the substance would appear white or gray. In the actual case as we find it in nature, the incident light is only partially absorbed, but the absorption is quite marked (and may even be almost complete) between certain wave-lengths, while in other parts of the spectrum there is little or no absorption. The absorbing substance, therefore, appears colored, since it absorbs certain wave-lengths with marked efficiency and gives off the others by reflection. In studying the absorption of light scientifically the spectroscope is employed, and the particular wave-lengths that are absorbed are determined by allowing the spectrum to fall upon a uniformly thick layer of the substance under investigation and examining the transmitted light to see what particular colors have been absorbed — absorption being indicated by the presence of dark bands (or «absorption bands») in the spectrum of the light that has passed through the test layer. In the case of the green coloring matter of plant leaves, the absorption band that corresponds to the photosynthetic activity is in the red part of the spectrum.

It is not possible to determine with precision the efficiency with which the absorbed vibratory energy of the light is converted into potential chemical energy in the leaf of a growing plant, but it is known that this efficiency is quite high. According to the best available estimates it may range from 40 per cent upward, and some authorities have even estimated it at 98 per cent in special cases.

The synthesis of highly organized compounds from carbon dioxide and water is performed by living organisms in various ways. Certain of the bacteria, for example, perform syntheses of this kind by utilizing the energy obtained by the simultaneous oxidation of hydrogen or other substances that may be present. Most of the plant life of the world, however, depends upon photosynthesis, effected through the agency of the green «chlorophyll» that the leaves contain. The coloring matter extracted from green leaves contains four recognizably distinct constituents — two of which are green and two yellow. The green substances appear to be the ones that effect the photosynthesis. One of them («a-chlorophyll») is bluish green in color and the other («b-chlorophyll») is yellowish-green, and appears to be an oxide of a-chlorophyll. These constituents are probably identical in all plants, and they contain magnesium and nitrogen, but no phosphorus or iron. The yellow pigments that are present in the leaves are carotin ($C_{40}H_{56}$) and its oxide xanthophyll ($C_{40}H_{56}O_2$). Carotin is identical with the «lutein» that occurs in the corpora lutea of mammals, and xanthophyll is isomeric with the «lutein» of fowl's eggs. The view that xanthophyll is related to cholesterol is now known to be erroneous. Carotin may perhaps assist in the decomposition of carbon dioxide.

There is a close and suggestive structural similarity between chlorophyll and the hæmoglobin of the human blood, and this fact may lead to a further understanding of the way in which chlorophyll acts. We do not yet know how it affects the synthesis of starch and sugar from carbon dioxide and water. In the living leaf the chlorophyll occurs in the form of concentrated layers upon (or near) the surfaces of certain tiny structural granules called «chloroplasts,» which appear to perform an important function of some kind or other. It has been shown, for example, that when a seedling is grown in the dark and subsequently placed in the light it does not necessarily possess photosynthetic power as soon as chlorophyll appears in it; and this shows that other elements, structural or chemical, are needed before photosynthesis can occur. It is also interesting to note that a mere trace of chloroform vapor in the air stops photosynthetic activity, even in a healthy and vigorous leaf.

The fascinating suggestion has been made that formaldehyde is first formed in the leaf in accordance with the simple equation $CO_2 + H_2O = CH_2O + O_2$. If it could be demonstrated that this action really occurs, we should probably be justified in the expectation that the mysteries of the green leaf will soon be cleared up. Formaldehyde easily polymerizes with the formation of higher compounds, and there would not be any great difficulty, apparently, in accounting for the formation of starch, sugar and other related substances after formaldehyde had once been obtained. The fact that formaldehyde has a strong toxic effect on living matter would not necessarily constitute an objection to the theory, because the formaldehyde might become polymerized, in the growing leaf, almost as rapidly as it was formed, so that it would never be present in sufficient quantity to exert a harmful influence. Considerable doubt has been thrown upon the formaldehyde hypothesis by the work of Schryver, Wager and Warner, who find that although an aldehyde of some kind appears to be formed in the leaf, it probably is not formaldehyde. Moreover, the presence of carbon dioxide is not essential to its production.

The carbon dioxide absorbed by the leaf may combine, first, with the chlorophyll and then split off in a different form, but we have no proof as yet that an action of this kind occurs.

For a good general discussion of the known facts concerning photosynthesis consult Bayliss, 'Principles of General Physiology.' For detailed data regarding the composition and constitution of chlorophyll consult Stewart, A. W., 'Recent Advances in Organic Chemistry.'

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PHOTOTHERAPY, the treatment of disease by light — sunlight and electric light (For treatment by the Roentgen ray or X-ray, see RADIOTHERAPY).

From the very earliest times sunlight has been considered an important aid in the preservation of health. The ancient Greeks and Romans exposed their naked bodies to the sun in the open air to recruit mental and physical energies, and built balconies or terraces (*solaria*) on the roofs or southern walls of their dwellings, so that the occupants could sun themselves. Exposure to the sun's rays was also adopted by the physicians of those times as a remedy for many affections, «especially dropsy, inflammation of the kidneys, and paralysis.» Celsus, the Latin writer, recommended for those with weak digestion a house «well lighted, having the winter sun»; but while he and Galen advocated sunlight as a remedial agent they pointed out the evils resulting from excessive insolation. Much has been written within the last century on the remedial value of sunlight. In 1815 Cauvin presented a thesis «on the benefits of insolation»; prior to 1820 Ebernier, Girard and others discussed the effects of sunlight on animal life; and in 1847 Richter, at Göttingen, wrote on «insolation, or the power of the sun on the human body.» In 1848 Perreira spoke of solar light as a «vivifying and vital stimulus,» adding: «In maladies characterized by imperfect nutrition and sanguinification, as scrofula, rickets and anæmia, and in weakly subjects with œdematous limbs, free exposure to solar light is sometimes attended with the happiest results.»

The importance of light for healthy growth and development has been recognized by sanitarians for many years. Solaria or sun-rooms are a part of some modern hospitals. Houses and rooms receiving little or no sunlight are unhealthful. In a military barrack at Saint Petersburg the mortality was three times greater on the dark than on the light side of the building. Animals and plants living in the dark become bleached, as is celery. Clinical observations show that a want of sunlight produces depression of spirit, lack of energy, loss of appetite, disturbance of digestion, turbid urine and a kind of homesickness. The face becomes pale (etiolation), the blood is thin, the red corpuscles are diminished, pulse is frequent and weak, palpitations of the heart occur on the slightest exertion, there is muscular debility, little recuperative power, and an increased susceptibility to contagious diseases.

Interesting experiments and observations have been made as to light, by Becklard, Becquerel, Draper, Edwards, Gardner, Hunt, Landgrebe, Hammond and others; but, as one of the writers observes, «we do not know what is the exact effect produced by light. Does it,» he inquires, «act directly, or is its only effect to modify the intensity of certain functions, such as respiration?» Later Edward Smith proved that light is a powerful stimulus to respiration, that «under the influence of daylight one-third more atmospheric air enters the lungs than under darkness or even under exposure to artificial light.» Hence the vigor of the «ruddy, healthy peasant who retires to rest with his cattle and is up with the lark» is believed to be mainly due to the thorough oxygenation and subsequent reddening of the blood by much contact with oxygen in the light and air of the day. Where direct sunlight cannot be obtained in rooms, reflected sunlight by means of mirrors has been found serviceable, in the maintenance of health. A room with a southern exposure is desirable. Sternberg and others have shown that bright sunlight, independently of the heat of the sun, is germicidal, destroying various pathogenic organisms, sometimes within a single hour. Sunlight is thus an important disinfectant. The sterilizing influence of light in the purification of water and sewage has been repeatedly proved (see STERILIZATION). But the fact that the germicidal property of light chiefly depends on its blue and violet rays was proved by Finsen near the close of the 19th century. It has been recently stated that the strongest sunlight has too feeble bactericidal properties for therapeutic purposes; for example, it does not kill bacterial skin-disease in the summer; but a concentrated focused light, transmitting as many blue, violet and ultra-violet rays as possible, such as the concentrated electric light of Finsen, is necessary. This light kills bacteria in a few seconds when spread on a thin film of agar. But Angell in 1878 had reported cases of acne speedily cured «by exposure to direct and entire sunlight.»

Light has long been considered a complex agent. It has been known that the sunbeam is resolvable into rays of various colors (violet, indigo, blue, yellow, green, orange, red), which embody luminosity, heat and actinism, the chemical property of light. It was known that the red rays of the spectroscope were heat-rays; that the rays toward the violet side were actinic or chemical; that luminosity was strongest in the orange and yellow rays. Later it was discovered that there are invisible heat-rays beyond the red, and actinic rays beyond the violet, and these were called ultra-violet. About 1845 Gardner and R. Hunt experimented with the rays separated by a prism, and ascertained some interesting facts as to the effects of blue, yellow and violet rays upon vegetation. Ponza, an Italian physician, found blue and violet light to be soothing to the insane. Gen. Alfred Pleasanton, in his advocacy of blue light as an invigorator, claimed too much for it, and the «blue-grass» craze died out. Most physicians believed that treatment by isolated rays of light did not possess «very essential therapeutic value.» A few clung to the idea that if the excess of heat and light could be eliminated the actinic rays might be of value.

It was reserved for Niles R. Finsen, a physician of Copenhagen, in 1895, to utilize scientifically the constituent or spectroscopic elements of light as therapeutic agents. In 1832 Pictou of New Orleans published a pamphlet proving that the absence of light would prevent suppuration and pitting (scarring) in smallpox, and recommended that the eruption should be protected from air and light. Finsen, by numerous experiments on worms and insects, convinced himself that under red light they were comfortable, and under blue light were irritated. Then reading Pictou's pamphlet, he inferred and advised that keeping smallpox patients in a red light would be as efficacious as darkness in preventing pock-marks by excluding the irritating actinic rays. If the skin is protected against the chemical rays inflammation will diminish and suppuration be prevented. In August 1893 Svendson in Norway and in November 1893 Benckert in Sweden used the red-light treatment with smallpox patients, and found that suppuration was abolished, scars were rare and insignificant and the disease was shortened. Even a very little daylight admitted to the room did harm, so sensitive was the inflamed skin to the actinic rays. In mild cases a clear red light was found sufficient; in severe cases a deep red light was necessary. Having proved that red light was inimical to the germs of smallpox and other eruptive diseases, Finsen turned his attention to the effect of decomposed light on other germ-diseases, especially lupus. He proved (1) that the bactericidal action of light is practically limited to the blue, violet and ultra-violet rays, and is greatly intensified by concentrating the rays by means of a suitable apparatus; (2) that the actinic rays so concentrated will penetrate the skin to a small degree and will go deeper if the red blood be pressed out of it — hence they would be of value in superficial cancer, baldness of microbic origin, acne, etc.; (3) that they have power to produce inflammation of the skin (*erythema solare*). Finsen's first case of lupus was successfully treated in 1895, with an ordinary arc electric light and a hand-lens, the red and ultra-red rays being filtered out through blue water. He then devised and used a sun-apparatus consisting of two lenses of glass, one plain, the other convex, framed in a brass ring, mounted on a stand, and which admitted of adjustment and focusing. Between the lenses was a bright blue weak ammoniacal solution of copper sulphate. Discovering that the ultra-violet rays were more efficacious than the violet in killing bacteria, he abolished the blue-water filter which prevented the ultra-violet rays from passing, and used clear distilled water, which sufficiently absorbs the red and ultra-red burning rays. Lenses of clear quartz-crystal were substituted for those of glass, it being found that they are better heat-filters and allow the chemical rays to pass almost unimpaired. As sunlight could not be depended upon for regular and systematic treatment, Finsen turned to the electric light.

The Finsen apparatus as now constructed consists of an arc-lamp, of from 40 to 80 amperes and one or more telescopic tubes of brass for concentration and focusing. Each tube closed is three feet four inches long and can be extended 10 inches. The head-piece of the tube has two plano-convex lenses of quartz-crystal, one with the convexity toward the light, the other with the plane surface in contact with the plane surface of the first lens. Toward the lower end of the tube there is a chamber for distilled water, designed to diminish the heat-rays not eliminated by the crystal lenses. The light-rays, emerging from this bath, are concentrated by another quartz-crystal plano-convex lens at the distal end of the tube upon the surface to be treated, the convex surface of the lens being toward the patient. To enable the rays to penetrate the surface more deeply by squeezing out the blood a compressor may be used, consisting of two quartz-crystal lenses, one plane, the other convex, with a chamber between having an inlet and outlet, through which water can be kept continuously flowing still further to cool the rays. This compressor is either held in place by an attendant or tied on. An improvement by Hopkins of Brooklyn admits of the adjustment of the tube on a stand to suit the case to be treated, as in uterine carcinoma.

The objection to the Finsen apparatus are the cost, the usually frequent and tedious treatment necessary — one hour a day for months — and the effects sometimes produced on the eyes. It has mainly been used in cases of *lupus vulgaris*, and *lupus erythematosa*, birth-marks, acne, and rodent ulcer. Dr. Rollier of Switzerland has had great success in employing the sun's rays for the open air treatment of tuberculous joint affections in children.

Though Finsen's discovery may not do all that has been claimed for it, it marks a great advance, especially in the cure of lupus. Out of 456 cases treated by Finsen, 130 were cured; the disorder had not recurred in from one to five years. Cases of abdominal malignant cancer have been successfully treated in this country. It is claimed by originators of improved apparatus that as much can be done therewith for lupus in 20 minutes as Finsen effected in an hour or more, that only 30 amperes, instead of 80 are necessary and that one application in several days is sufficient.

The Minim light, suggested by Minim of Saint Petersburg, which is an ordinary incandescent light, covered by a bulb of natural blue glass, with a reflector, has proved valuable in the treatment of various forms of ulcers, in *alopecia areata*, in contusions and in other acute injuries. Minim also offers this light as a substitute for the Finsen light in lupus.

Doctor Hopkins of Brooklyn claims the treatment by the light of the Hopkins lamp is a cure for pulmonary tuberculosis in the first stage, as well as for many cases in the second stage and that it has been of great comfort and has prolonged life in a number of instances in the third stage of the disease. The lamp consists of a 50-ampere searchlight in a brass cylinder, with a French condensing-lens, 18 inches in diameter. It focuses at a distance of about 12 feet. The light passes through a sectional screen of blue glass, two feet square, to cut out the heat-rays and impinges upon the chest of the patient. Half-hour exposures to this light are found to be sufficient.

The German Light-Bath is used for treating the naked body by concentrated light. It consists of a couch in a cabinet or sheet enclosure, with two or more lamps within it comprising from 40 to 80 amperes. This bath of light has proved efficacious in malnutrition, marasmus, and various forms of debility and in neurasthenia and other neurotic affections.

The mercury vapor lamp of Kronmayer, in which the rays are passed through a window of rock crystal, the crystal not filtering out the ultra-violet rays has made it possible to project intense radiations and so produce very violent reactions from short exposures. By careful management it is possible thus to remove angioma, rosacea, patches of lupus, etc. In carbuncles, radiant light and heat may be employed alone to abort the condition if applied in the early stages and for long periods. Light has proved effective also in tuberculosis, peritonitis and other tuberculous conditions.

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PHOTOTOPOGRAPHER. See SURVEYING.

PHOTOTROPISM, same as heliotropism (q.v.).

PHRANZA, frän'zą, or **PHRANZES,** frän'zās, **George,** Byzantine historian: b. 1401; d. about 1477. He was chamberlain of Manuel II (Palæologus) and was a warrior and diplomat in the service of Constantine XIII, whose life he saved in the siege of Patras (1429). After the capture of Constantinople by Mohammed II (1453) he escaped to Corfu and retiring to a monastery, wrote his interesting and reliable 'Chronicon' or Byzantine history, covering the period from 1259 to 1477 and the chief authority for the author's own time. There are editions by Alter (1796) and Bekker (with Latin translation 1838).

PHRASE, *in music,* a short division of a composition, in compound time sometimes contained within one measure, but usually consisting of two or more measures, closing with a half-cadence or a cadence. Two united phrases ending in a cadence form a section, and two sections, the first terminating with the dominant, and the second with the tonic harmony, constitute a perfect musical idea. The musical phrase is analogous to the literary sentence; their proper interpretation and rendition, termed «phrasing,» into which the due elements of accent and rhythm enter, is one of the distinguishing characteristics of the art of the vocalist or instrumentalist, without which any musical performance is merely mechanical. The term phrase is applied also to any short passage performed without break, and the irregular phrase qualifies a passage with any unusual number of measures.

PHRENOLOGY (Greek, *phren,* mind; *logos,* discourse), the science which teaches that there exists a relation between the several faculties of the mind and particular regions of the brain, and that these are the organs of those faculties; in accordance with this theory phrenologists chart the cranium of man in sections, each section being taken to represent the seat in the brain of some definite faculty or mental or moral disposition. That the brain as a whole is the organ of mind we should incline to regard as an instinctive judgment were it not that some of the most highly gifted races, as the Hebrews, the Egyptians, nay even the Hellenes, as is proved by their vocabularies and their literature, recognized various organs and viscera as the seats of the intellective and of the emotional faculties; the heart, for example, was for the primitive Romans the seat of understanding, of wisdom, as also for the Egyptians, the Hebrews, the Greeks; but at the same time it was for them the organ of feeling and emotion. But Pythagoras (6th century B.C.) held the brain to be the seat and organ of understanding; yet Aristotle, 200 years later, taught that the heart is the master organ of life and inelligence, and that the brain is a cold, inert, bloodless organ, the sole function of which is to temper the heart's excessive heat. But for Plato the heart was the chief organ of intellect, and the great naturalists, anatomists, and physicians who lived later adhered to Pythagoras' view despite the very high authority of the Stagirite. Even in the Middle Ages when Aristotle's authority was supreme, the scholastic philosophers rejected his doctrine on this point, and Albertus Magnus, in the 13th century, and very many other philosophers and naturalists after him, divined a localization of faculties in the brain. Albertus saw in the anterior region the seat of judgment or ratiocination, in the medial, that of imagination, and in the posterior region the seat of the memory; and his successors in a similar way distributed the seats of the several faculties of the soul in the different regions of the brain. Hence, Francis Joseph Gall, though justly accounted the founder of modern phrenology, did but revive the ancient knowledge and develop it further. He expounded his views on the subject in lectures at Vienna in 1796 and later, but in 1802 was compelled to discontinue them by order of the Austrian government prompted by the ecclesiastical authorities. Gall had already attached to himself a gifted pupil and efficient coadjutor in the person of John Gaspar Spurzheim, and the pair pursued their investigations in concert and delivered lectures on phrenology throughout France and Great Britain. In both countries they gained enthusiastic disciples not only among the less educated class but among the learned also — such men as Sir George Mackenzie, Archbishop Whately, Laycock, Macnish, Andrew Combe: the last named was universally recognized as the ablest expositor of the doctrine in Great Britain, and its indefatigable propagandist. Phrenological societies sprang up everywhere in England and the United States, and the principles of the science were propounded and defended in a number of periodicals, British and American, the first both in point of time and in authority being the British *Phrenological Journal*, published in Edinburgh and edited by Dr. Combe till his death in the United States, 1847. The popular interest in phrenology which for 30 years or more was at fever heat languished and died away till now phrenological societies are heard of no more and phrenology for years had but one representative in the periodical press of the United States. Fowler and Wells of New York were the last publishers to take an active interest in the science, and Nelson A. Sizer was the last of active phrenologists.

Phrenology, as finally developed, is the work rather of Spurzheim and of Combe than of its first founder, Gall. Gall located 27 special faculties out of the 35 usually recognized; but to Spurzheim is due the credit of having systematized and justified Gall's data and of having enriched the science with important discoveries. Not the least of Dr. Spurzheim's merits is the improvement made by him in the nomenclature of the science: for example, when what in Gall's scheme is called *murder*, Spurzheim calls *destructiveness*, a term which is more comprehensive as well as more exact; or when of Gall's two terms *veneration* and *religion* Spurzheim retains only the first, in which the second is comprised. The 27 faculties identified by Gall are by Gall himself named and numbered as follows: 1, veneration; 2, love of offspring; 3, friendship; 4, courage, self-defense; 5, murder; 6, cunning; 7, the sentiment of property; 8, pride, self-esteem, haughtiness; 9, vanity, ambition; 10, cautiousness; 11, memory of things, educability; 12, local memory; 13, the memory for persons; 14, memory for words; 15, memory for languages; 16, colors; 17, music; 18, number; 19, aptitude for drawing conclusions; 22, wit; 23, poetry; 24, good nature; 25, mimicry; 26, religion: 27, firmness of character. (The numerical figures do not apply to Spurzheim's phrenological chart).

Spurzheim classified these faculties, propensities and other characters as follows:

SPURZHEIM'S CLASSIFICATION AND LOCALIZATIONS.

Spurzheim recognizes two great classes of human faculties, namely:

I. Feelings, divided into:
  1. Propensities, or predispositions only to certain kinds of acts.
  2. Sentiments, or impulses which prompt to emotion as well as to action, and these are either
     a. Lower, common to man and lower animals; or
     b. Higher, peculiar to man.

II. Intellective faculties:
  1. Perceptive faculties.
  2. Reflective faculties.

PROPENSITIES.

1. Amativeness. 2. Philoprogenitiveness. 3. Concentrativeness. 4. Adhesiveness. 5. Combativeness. 6. Destructiveness. 6a. Alimentiveness. 7. Secretiveness. 8. Acquisitiveness. 9. Constructiveness.

SENTIMENTS: LOWER.

10. Self-esteem. 11. Love of Approbation. 12. Cautiousness.

SENTIMENTS: HIGHER.

13. Benevolence. 14. Veneration. 15. Conscientiousness. 16. Firmness. 17. Hopefulness. 18. Wonder. 19. Ideality. 20. Wit. 21. Imitation.

PERCEPTIVE FACULTIES.

22. Individuality. 23. Form. 24. Size. 25. Weight. 26. Color. 27. Locality. 28. Number. 29. Order. 30. Eventuality. 31. Time. 32. Tune. 33. Language.

REFLECTIVE FACULTIES.

34. Comparison. 35. Casualty.

Phrenology was popular during the middle of the 19th century, but suffered from the lack of true science displayed by many of its advocates, who assumed altogether too much for it, and made money out of it by charting heads of those interested at from 50 cents to $5 per chart. The most necessary thing for a professor of phrenology was a happy faculty of flattering everybody, and the more they flattered the more people paid to have their heads charted, to get information as to their characteristics. A few men of large perception, like the late Nelson A. Sizer, gave value for the examinations they made, but they appear to have used physiognomy to assist them, and to have been also very shrewd observers, discovering characteristics in half a dozen ways, besides examining the skulls of their subjects. Another blow was given phrenology as anatomy advanced. The study of the brain functions on the dissecting table did not carry out all the assumptions of the phrenologists; the colleges refused to teach it as a science, and it gradually fell into desuetude. Yet there seems to have been a mistaken haste in condemning phrenology. Like chiropractic science,— which was developed by non-scientific men, until the scientific had to take it up and acknowledge its many virtues — phrenology contains truths that should not be overlooked. Herbert Spencer emphasizes these: «No physiologist can long reject the conviction that different parts of the cerebrum subserve different kinds of mental action. Localization of function is the law of all organization; separateness of duty is universally accompanied with separateness of structure, and it would be marvelous were an exception to exist in the cerebral hemispheres. . . . These more or less distinct kinds of psychical activity must be carried on in more or less distinct parts of the cerebral hemisphere.» Dr. Bernhard Hollander investigated the subject at great length, and endeavored to find proof in hospital records, finally giving his attention mainly to cases of mental disease and injury, and the effects on the areas of the brain. After an examination of hundreds of cases, which he cites in his book, 'The Mental Functions of the Brain,' he concludes: «(1) Melancholia is especially associated with injury or disease of the parietal lobe of the brain. (2) Mania *furiosa* is especially associated with injury or diseases of the central portion of the temporal lobe. (3) Mania with suspicions and delusions of persecution is especially associated with injury and disease of the posterior portion of the temporal lobe.» Dr. Hollander deprecates the false notion of «bumps» and «depressions» of the skull as indications of faculties, while claiming that the general development of certain areas is evidence of certain characteristics; and this is borne out by common observation. No one of any fair degree of observation on being shown the portraits of the philosopher Emerson, the prizefighter John L. Sullivan, and the capitalist Andrew Carnegie could fail to decide at once which was which. Prizefighters have big thick strong back-heads; unselfish philosophers have small back-heads, but very high heads; while accumulating business men have broad faces, and usually heads long from front to rear, rather than long in height. Some men have a special ability for judging of the character of men applying for employment, and putting the right men in the right places — they are natural phrenologists; but it must be admitted that they use other means than examining the heads of applicants. Phrenology was disowned by science because too much was claimed for it, and too much expected. Like physiognomy (q.v.) it is a valuable aid to estimating character.

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PHRIXUS, phrĭk'sŭs, *in Greek mythology,* the son of Athamas and Nephele, and the brother of Helle. When about to be sacrificed to Zeus, he was rescued by his mother and carried with his sister to Colchis upon a ram with golden fleece. Helle fell into the sea and was drowned on the way and the waters where it took place were called the Hellespont. It was the fleece of this ram, given to King Æetes, and kept by the king in a garden guarded by a fiery dragon, in search of which Jason went in the expedition of the Argonauts.

PHRYGIA, frij'i-ą, *in ancient geography,* a country of Asia Minor, occupying the central plateau west of the Halys and the interior desert, but otherwise very ill-defined, since the country varied much at different times and in general was an ethnological rather than a geographical term, as it was applied to the district occupied by the Phryges or Phrygians. The region was broken by sharp valleys, was extremely fertile, especially on its western slope, and was rich in gold as is evidenced by the myth of its King Midas. He was said to be the second king of the country succeeding his father Gordius, a common laborer who founded the kingdom, about 800 B.C. The names of Gordius and Midas are frequently repeated in the list of Phrygian kings, and this account of the foundation of the kingdom is scarcely credible. Indeed it seems that a much earlier Phrygian civilization spread over Lydia, Cappadocia and Lycaonia as well as Phrygia, leaving behind it monuments of its peculiar art and a road system later utilized by the Persians. Intercourse with the Greek cities of Asia Minor seems to date from the 9th century B.C., and with the European Greeks, through the colony of Sinope (founded 751) in the 8th century. But 100 years later the Phrygian kingdom was wiped out (680–670 B.C.) by the invasion of the Cimmerians, who seem to have held the country till about 620, when the Lydians conquered Phrygia, to hold it until the conquest of Lydia by Persia. Persia's downfall transferred Phrygia to Macedonia, and it became a part of Pergamus, and in 90 B.C. was incorporated into the Roman province of Asia. Phrygian slaves were highly prized among the Greeks, probably as early as the 5th century.

Ethnologically the Phrygians seem to have been closely related to the Armenians. Both were of Indo-Germanic stock, as has been proved by recent studies on the Phrygian language, which is known to us only from the scanty remains of widely scattered inscriptions and a few glosses; many of the funeral inscriptions are in Greek, save for the curse at the end on him who «disturbs my bones,» which was written in Phrygian. The language, like Armenian, seems to be Iranian in its affinities. Inscriptions in its peculiar alphabet, the exact value of some signs which are still unknown, are found in Lemnos and in Egypt. Some few of its words agree almost exactly with the Greek, and many loan words from the Phrygian seem to be found even in the Homeric dialect. Most of the sepulchral inscriptions alluded to are found on tombs with peculiar conventional pattern of great boldness and skill in design, the figures being mostly of a heraldic type strangely suggestive of Oriental rugs. The most famous of these tombs are those of the early kings, including Midas, in the hills near Sangarius — all apparently were memorials and not actual burial places. The Phrygians seem to have been essentially a rustic people, and their religion was a nature worship, in which the great divinity was Ma or Ammas, the Great Mother, also called Cybele, which seems to have meant «the mountain goddess.» Her seats were Dindymus, Sipylus and Ida, and she was the goddess of vegetation and of all life and generation. Her cult passed to Greece in the 5th century, and her black stone image was carried to Rome in 204 B.C. Closely associated with her was Attis, again a divinity of nature's powers of reproduction.

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PHRYGIAN CAP, or LIBERTY CAP, a peaked headdress worn by the ancient Phrygians. Such a cap when placed upon the heads of Greek and Roman slaves became a token of their freedom. Hence it has become a symbol of liberty. The Roman conspirators, after murdering Cæsar, carried it through the streets on a pole and it was stamped on coins. It was also connected with the French Revolution. Louis XVI was compelled to wear it in 1792 in order to show his agreement with the people's desires. In the same year it was made the mark of a «patriot.» It is also seen on the head of the Goddess of Liberty, on some of the coins of the United States, and has been adopted by some foreign countries, being inscribed on their coats of arms.

PHRYGIAN LANGUAGE. See PHRYGIA.

PHRYNE, frī'nē, famous Greek courtesan: b. Thespiæ, Bœolia, in the 4th century B.C. She was named Mnesarete, but on her coming to Athens, where she became a flute player and later a hetæra, was called Phryne (literally «toad») «because of her complexion.» She grew rich in her profession and became the mistress of the sculptor Praxiteles, who modeled after her his statues of Aphrodite and made two portrait statues of her. Many stories of her are told, the most famous being that of her promise to rebuild from her own purse the city of Thebes on the condition that the city should be inscribed «Destroyed by Alexander; rebuilt by Phryne» — an offer which was declined. Quintilian is the first authority for the story of her trial before the Areopagus, in which her lawyer Hyperides, seeing that he would lose the case, drew her clothes from her breast and shoulder, showing the judges a beauty so perfect as to force them to declare her innocent. During an Eleusinian festival, another story relates that she appeared in the sea bathing in full view of the pilgrims, a theme taken by the painter Apelles for his picture of Aphrodite Anadyomene (that is, «rising from the sea-foam»). In later art Phryne figures in a famous fresco at Pompeii, and in the painting of Gérome (1861), and in the statue by Pradier.

PHRYNICHUS, frin'ĭ-kŭs, early Greek tragic poet. He was an Athenian, won his first tragic victory in 511 B.C., and was writing in 476 B.C., at which time his ‹Phœnissæ› was presented with much pomp by Themistocles. Besides the ‹Phœnissæ,› which was imitated by Æschylus in the ‹Persæ,› Phrynichus wrote several works, the titles of nine others having been preserved. His ‹Capture of Miletus,› Herodotus says, was the cause of his being fined for thus employing a national calamity, and of a law against tragedies of political content. Phrynichus is said to have been the originator of several improvements in the drama.

PHTHA, thā. See PTAH.

PHTHIOTIS, thī-ō'tĭs, the southernmost of the tetrads of ancient Thessaly and now forming, with Phocis, a nomos, or governmental division of the Greek kingdom. The ancient district, famed as the home of Achilles, included the region about the Othrys range between the valley of the Sperchius and the great plain of Thessaly. The present division, which before 1899 formed a nomos together with Phocis (q.v.), has now been separated; its area is about 1,800 square miles; pop. about 73,000. Capital city Lamia.

PHTHISIS, thī'sĭs. See CONSUMPTION.

PHYCOCYANIN, fī-kō-sī'ą-nĭn, **PHYCOERYTHRIN, PHYCOPHÆIN,** pigments coloring the blue-green, red and brown seaweeds respectively. See ALGÆ.

PHYCOLOGY, that department of botany which treats of the algæ or seaweeds.

PHYCOMYCETES, PHYCOPHYTES. See FUNGI.

PHYFE, fīf', **William Henry Pinkney,** American author: b. New York, 13 June 1855; d. 7 March 1915. He received his education at Columbia College and devoted himself to a study of spelling and pronunciation, on which subject he wrote ‹The School Pronouncer; How Should I Pronounce?› ‹Seven Thousand Words Often Mispronounced,› subsequently revised to include 10,000 words; again in 1908, 12,000 words, and in 1914, 18,000 words. He was also the author of ‹Napoleon, the Return from Saint Helena› (1908).

PHYLACTERY (Gr. *φυλακτήριον*, a receptacle for safe-keeping. The Hebrew word means «frontlet»); a sort of small box containing four passages from the Pentateuch, namely, Exodus xiii, 1–10, 11–16, Deuteronomy iv, 4–9, xi, 13–21. The phylactery or *tephillah* was a small leather case fastened to a band, and each male Jew of 13 years of age and upward wears two of them at morning and evening prayer. One is bound round the head in such a way that the case comes between the eyebrows. In this case are four compartments, each containing a strip of parchment with one of the four passages above mentioned. The other band with a simple phylactery is fastened round the left arm, the little case being turned toward the heart. The practice of wearing these *tephillin* was developed out of the commands in Exodus xiii, 9 and 16, and Deuteronomy vi, 8, and in its present form dates from about the 1st century before the Christian era. In Matthew xxiii, 5, Jesus condemns the Pharisees for making broad their phylacteries. The name phylactery, from a Greek word meaning «to guard,» refers to their use as amulets for protection against demons.

PHYLÆ, fī'lē, *in Greek history*, the several tribes of a city or nation, each composed of men who traced their descent to a single common ancestor. The Ionians were made up of four such tribes which settled themselves in Attica, namely the Geleones, the Hopletes, the Agikores and the Argades. They were the foundation of the Athenian state and were divided into three phratries. Solon recognized these four Old Ionic tribes. Cleisthenes organized them into 10 tribes which he called after Old Ionian heroes; and these were again divided into demes. In 307 B.C. two new tribes were added, and these in honor of Demetrius and his father Antigonus were named Demetrias and Antigonis. A 13th Hadrianis was added in honor of the emperor Hadrian (123 A.D.). The Dorians had three tribes, the Hylles, Dymanes and Pamphyles, forming the main body of the state, and in Sparta were divided into 10 Obes.

PHYLARCHUS, fī-lär'kŭs, Greek historian, who flourished about 215 B.C. He was, according to some, an Athenian, according to others an Egyptian. He wrote 28 books of ‘Ἱστορίαι’ (‘Histories’), a work apparently containing accounts of not only Greece and Macedonia, but also Egypt and other contemporary states. It covered the period from the invasion of the Peloponnesus by Pyrrhus to the death of King Cleomenes of Sparta. Polybius and Plutarch attack his credibility, yet Plutarch made extensive use of Phylarchus' work in his own lives of Cleomenes and Aratus. Only a few fragments remain.

PHYLLIS, fĭl'ĭs, *in Greek myth*, a daughter of Sithon, king of Thrace, who from grief at the absence of her beloved Demophon took her own life, and was changed into a leafless almond tree. When Demophon returned and flung his arms around the tree it burst into full leaf.

PHYLLITE, (1) a mineral related to or a variety of ottrelite, found as micaceous scales in the mica schist of various parts of Massachusetts and Rhode Island. Hardness six to seven; color greenish-gray to black. In composition a hydrated silicate of iron, aluminum, and manganese. (2) A finely crystalline metamorphic rock which is a fine-grained mica schist and may be considered a transition type between an ordinary mica schist and a slate.

PHYLLIUM. See Leaf-insect.

PHYLLOCARIDA, a name given by Packard to the group of crustaceans called *Leptostraca* by other authors. But a single genus (*Nebalia*) is known, a small shrimp-like form occurring in seas of moderate depth. The group is characterized by having a bivalve carapace, 21 body-segments, of which eight are in the abdomen, and leaf-like thoracic feet resembling those of the *Phyllopoda*.

PHYLLOPODA, the most primitive group of existing crustacea. The name refers to the feet, which are broad leaflike structures, the thoracic appendages being unjointed, while those of the head are typically arthropodan. The number of segments of the body varies between very wide limits, those of the abdomen being without appendages. In all except the *Branchipidæ*, a carapace is developed, either as a broad oval plate covering the thorax, or as a bivalve shell closed by adductor muscles like a clam. The group is divided into the *Branchiopoda* (q.v.) with numerous segments, most of the species being inhabitants of fresh water (see Apus); and the *Cladocera* in which the segments number less than a dozen, the species being some inhabitants of fresh water, others of the sea. Most of the fresh-water species are normally parthenogenetic (see Parthenogenesis), the males appearing only at rare intervals; indeed the males of some species are unknown. Many are inhabitants of pools which dry up in hot weather: and it has been found that with some species the eggs need to be dried before they will develop. Many species lay two kinds of eggs, thin-shelled summer eggs and thicker-shelled winter eggs. In the *Cladocera* the dorsal part of the carapace serves as a brood-pouch, the eggs here undergoing their development, sometimes nourished by fluids secreted by the mother. The species of *Artemia* are remarkable from the fact that they live in salt springs and lakes, or in tubs and vats filled with brine, but are unknown in the sea or in fresh waters. (See Brine Shrimp). Consult Packard, A. S., ‘North American Phyllopod Crustacea’ (Washington 1883); id., ‘Text-book of Zoology’ (11th ed., New York 1904).

PHYLLOTAXIS, *in botany*, the arrangement of leaves on a stem, three common positions being opposite, alternate and verticillate. See Leaves.

PHYLLOXERA, or **VINE-PEST**, an American aphist (*Phylloxera vastatrix*), destructive to grapevines. It has four forms: sexual, leaf-gall, root and winged. The sexual female lays an egg upon the vines during the autumn. About the time the buds open, the larva hatched from this egg forms a gall upon the upper surface of a leaf and in about two weeks commences egg-laying, soon producing from 500 to 600 eggs within the gall it has made. The young which appear in about a week disperse to other parts of the vine and form galls like the first. During the summer six or more generations are produced and the leaves may be completely covered with galls. The last brood produced before cold weather migrates to the roots where the insects hibernate until spring. During the growing season of the second year several generations of wingless females are produced upon the rootlets which swell more or less at the points of attack. In early autumn these root forms may produce winged females, which fly to the vines and lay eggs to continue the life-cycle. Often, however, no winged forms may be produced for several years, the root forms being capable of continued reproduction under favorable conditions. Flight is not the only means the insect has for distribution; it may be carried by vines transplanted from infested vineyards to new ones, by birds and insects to whose bodies the leaf form may cling; by winds which carry the leaf form either with leaves torn from the vines or otherwise; and through the crawling of the root form through cracks in the earth.

Though the insect is an American species, it has done little damage upon American varieties, since these are more resistant, probably because of the thicker bark of their roots and their robust habit of growth. But upon the European varieties of *Vitis vinifera* the root-form is especially troublesome. It was introduced into France upon American vines about 1859, and not only in France but throughout the grape-growing sections of Europe it quickly spread and did enormous damage. It is now known in nearly all grape-growing countries of the world. It is believed to be responsible for the failures of European varieties in America where, however, it was unknown at first except in the Rocky Mountain region, and then, somewhat later, in California upon European vines. Since the root form, which is seldom seen, is the destructive form, methods for combating it were rarely satisfactory. The most frequently tried were probably bisulphide of carbon injected into the soil and flooding the ground. The one preventive remedy now practised is the grafting of the European varieties upon the roots of American varieties, especially those derived from *Vitis labrusca, V. æstivalis,* and *V. riparia*. Since this discovery was made, experiments have been made in the growing of European varieties in America, the vines having American roots, the object being to discover the cause of previous failure of the European varieties. Consult Marlatt, ‹Principal Insect Enemies of the Grape› (United States Department of Agriculture, Farmers' Bulletin, No. 70; Washington 1898). See Grape Insect-pests.

PHYLOGENY, the development or evolutionary history of an animal group considered as a whole. This branch of knowledge is based on the study of embryology of animals and the facts thus brought to light, which are supplemented by the study of paleontology. See Evolution; Paleontology.

PHYSA. See Pond-snail.

PHYSALIA. See Portuguese Man-of-War.

PHYSIC-NUT, or CURCAS, the seed of *Jatropha purgans,* or the plant itself, a tropical shrub belonging to the order *Euphorbiaceæ.* These seeds have strong emetic and purgative properties, due to a fixed oil which is expressed and used in medicine under the name of jatropha-oil. The seeds of another species (*J. multifidus*) are called French or Spanish physic-nuts, and these yield oil of pinhoen. See Jatropha.

PHYSICAL CONSTANTS. See Units of Measurement; Weights and Measures.

PHYSICAL CRYSTALLOGRAPHY treats of the physical properties of crystals and their determination. In general any measurable property will yield results varying with the direction and alike only in directions which are structurally equivalent. If these results are represented by straight lines of proportionate length in the given directions they determine a closed surface which in symmetry and dimensions represents that property in that crystal.

The physical characters may be subdivided into those which depend upon cohesion and elasticity, and upon the action of radiant energy (light, heat, magnetism and electricity).

The Properties Dependent upon Cohesion. — The resistance opposed by a crystal to forces tending to separate its particles is shown by various important properties, as cleavage, gliding, parting, percussion-figures, etch-figures, corrosion and hardness. Of these *cleavage* has been described, see Cleavage, and *hardness* is discussed under the article Mineralogy.

Gliding is the tendency of the particles to slip or glide without separation parallel to a so-called gliding plane, which is always a possible crystal face, when pressure is exerted in a certain direction. Thus if a slender crystal of stibnite supported at the ends is pressed downward with a dull knife edge, it is bent at this point without affecting the other parts. The gliding may be accompanied by a revolution of 180 degrees bringing a part of the crystal into twinning position. Unlike cleavage planes, which are at right angles to directions in which the particles are furthest apart, gliding planes are at right angles to directions in which the particles are very close together.

Parting.—The planes along which gliding has taken place often become planes of easy separation and are then called parting-planes. Parting resembles cleavage, but is distinguished by the fact that it takes place only in certain definite planes, those of the molecular disturbance, while cleavage may be obtained in any part of the crystal in the given direction.

Etch figures.— When a crystal is attacked by any solvent the action proceeds with different velocities in crystallographically different directions, and if stopped before the solution has proceeded far, the crystal faces are often pitted with little cavities of definite shape usually bounded by minute faces.

The figures, whatever their shape, conform in symmetry to the class to which the crystal belongs and as the faces rarely belong to limit forms common to several classes, etch figures are very useful in determining the true symmetry of the crystal.

Etch figures are alike on faces of the same crystal form and generally unlike on faces of different forms.

Corrosion.— The unequal rapidity of solution in different crystallographic directions is sometimes studied by immersing a crystal in a solvent. This may result in the development of new faces conforming in position to the symmetry of the crystal. Sometimes a sphere is cut from the crystal and submitted to the action of the solvent. Thus a sphere of quartz subjected to the prolonged action of hydrofluoric acid was attacked rapidly in the direction of the vertical axis but scarcely at all in the direction of the horizontal axes, the resulting form being a subtriangular lens.

Percussion Figures.— Cracks parallel to crystallographic directions are sometimes developed by pressing or tapping a conical point against a face of a crystal. Examples are mica and common salt.

The Properties Dependent upon Elasticity. — If rods of the same length, breadth and thickness are cut from different parts of the same crystal and subjected to equal strains, they are found to undergo different extensions, and if, from the resulting coefficients of extension for all directions, the extension surface is constructed, this, while often a very complex shape, is found always to be symmetrical to the axes and planes of symmetry of the crystal.

Pressure in different directions will modify the optical characters of a crystal. For instance, isotropic crystals may be made to yield uniaxial or biaxial phenomena according to the direction in which the pressure is applied.

The Optical Properties of Crystals.— Although the electromagnetic theory of light is now generally accepted, the terminology of the older undulatory theory is still conveniently used in discussing the optical characters of crystals. It is assumed that while the direction of advance in a homogeneous medium is in straight lines, the transmission is due to vibration (or waxing and waning of force) at right angles to this direction of advance. This may be called a vibration and designated in direction and intensity by a straight line. The advance during a complete vibration is called a wave length and determines the color of the light while the amplitude of the vibration determines the intensity.

The properties of light are elsewhere described (see LIGHT). Those most used in the study of crystals are refraction, double refraction, polarization and absorption. In other words, because crystals on account of their structure retard the transmission of light differently in different directions, both with respect to the velocity of transmission and the quantity transmitted, these properties of transmission are utilized to determine crystalline structure.

Refraction.— Rays of light in passing *obliquely* from one medium to another in which the velocity of transmission is different are bent or refracted. If the velocity is lessened the bending is *toward* the perpendicular to the surface of contact, if the velocity is increased the bending is *away* from the perpendicular.

The ratio of the velocities of light in the two media is called the *index of refraction* of the second medium with respect to the first and it has been proved that whatever the angle of incidence, the ratio of the sines of the angles of incidence and the angle of refraction is constant for the same two media and equal to this index of refraction. That is, $n = \frac{\sin i}{\sin r} = \frac{V_1}{V_2}$

Double Refraction.— In 1679 Erasmus Bartholin observed that the objects viewed through iceland spar appeared double, one image conforming to ordinary refraction, the other not so conforming. For instance, one of the two rays had a fixed index of refraction (1.658 for yellow light) while the index of the other varied for different directions of transmission from 1.658 to 1.486. As early as 1678 Huyghens showed that the optical behavior could be represented by a double shelled surface like that later described under optically uniaxial crystals.

Double refraction could be proved for only a few crystalline substances by the direct observation of double images. Other methods, however, prove that it is a general property of all crystals except those of the isometric system.

Polarized Light.— In ordinary light the vibrations are assumed to take place at right angles to the line of transmission but in any plane. Malus discovered that light reflected from inclined plates of glass, when viewed through the doubly refracting iceland spar, gave images which differed in intensity, and that for certain positions of the iceland spar one or the other image disappeared. Light so modified is said to be polarized and the vibrations are considered to take place in one plane only.

The rays transmitted by any doubly refracting crystal consist of polarized light and for any direction of transmission the planes of vibration of the two emerging rays are at right angles to each other.

Absorption and Pleochroism.— Light passing through any substance is partially absorbed, the amount increasing with the thickness. If the light is composite the component lights of different wave length may not be absorbed in the same ratio and the substance will appear of the color due to the unabsorbed portions of the components.

In doubly refracting crystals the two rays transmitted in any direction are apt to undergo different absorptions and may emerge of different color and intensity. Furthermore in different directions in the same crystals the so-called «twin colors» may notably differ and in such a case the «pleochroism» is observable by the eye alone. Thus a crystal of iolite appears bluish in one direction and yellowish in another.

The Optical Classification of Crystals.— According to their optical behavior crystals may be classified as 1. Optically isotropic, 2. Optically anisotropic uniaxial, 3. Optically anisotropic biaxial.

Optically Isotropic Crystals.— Isometric crystals show the same optical properties in all directions, yielding in all directions the same index of refraction and the same rate of absorption. They are singly refracting or rarely circularly polarizing.

Optically Anisotropic Uniaxial Crystals.— In tetragonal and hexagonal crystals the optical behavior varies with the direction, the principal crystallographic axis is also an axis of optical symmetry, for in all directions equally inclined to it the same optical tests are obtained. It is a direction of single refraction or of circular polarization.

The optical properties of a uniaxial crystal are best understood by considering the shape of the Ray Surface, which consists of two shells with a common centre. One is a sphere, the other an ellipsoid of revolution, each passing through points on the rays determined by the velocities of transmission.

Evidently for every direction except that of the optic axis *two* rays are transmitted, an ordinary, with a velocity indicated by the sphere radius, and an extraordinary, with a velocity indicated by *the corresponding radius vector of the ellipsoid,* and the greatest difference of velocity exists for the direction of transmission at right angles to the optic axis.

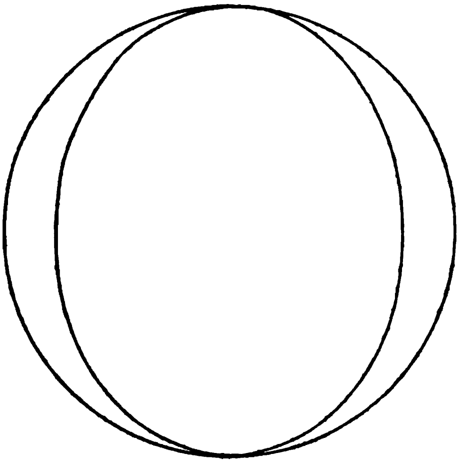

FIG. 1.

The spherical shell may surround the ellipsoid shell or vice-versa. The former combination is called a positive ray surface (Fig. 1), the latter a negative (Fig. 2).

The Optically Anisotropic Biaxial Crystals.—In all orthorhombic, monoclinic and triclinic crystals, the optical behavior varies with the direction, and while there are no true optical axes, there are, for monochromatic light and constant temperature, two directions of single refraction which are called optic axes from analogy with the direction of single refraction in the uniaxial crystals.

The ray surface consists of two intersecting shells symmetrical only to three lines at right angles and to three planes each through two of these lines. Two of the three lines are the vibration directions of the fastest ray and the slowest ray. It may be noted that when planes or axes of geometric symmetry exist they coincide with planes or axes of optical symmetry.

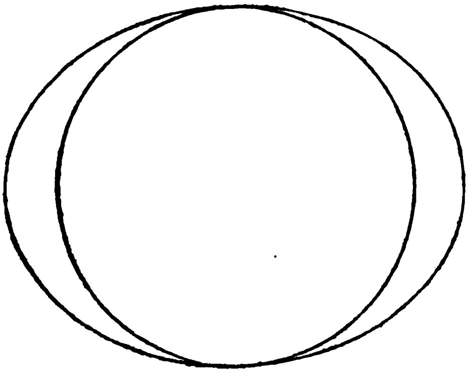

FIG. 2.

If the vibration directions of the fastest and slowest ray are denoted by X and Z respectively and a direction at right angles to these by Y, the shape of the ray surface may be judged from the shape of the principal sections XY, XZ and YZ.

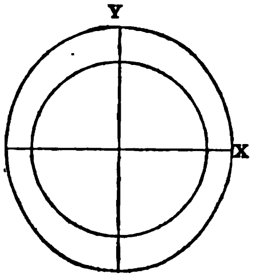

FIG. 3.

The section XY (Fig. 3) cuts the two shells of the ray surface as a circle within an ellipse with radius, major and minor axes respectively slowest, fastest and intermediate velocities, while the section YZ (Fig. 4) cuts the two shells of the ray surface as an ellipse within a circle with radius, major and minor axes respectively fastest, intermediate and slowest velocities.

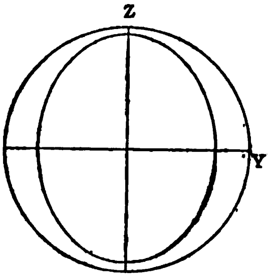

FIG. 4.

The section XZ, the plane of the optic axes, cuts from the ray surface an ellipse and a circle which intersects the ellipse in four symmetrically placed points, E (Fig. 5). The radius, major and minor axes are respectively the intermediate, fastest and slowest velocities.

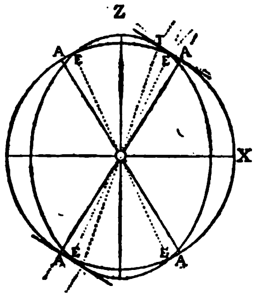

FIG. 5.

Near but not *at* the points E common tangent planes can be drawn to each shell. The directions, AA, normal to these common tangent planes are directions of single refraction, the so-called *optic axes.* The acute angle between these is called the *optic axial angle.*

As in the uniaxial ray surfaces there are two types, the described sections being those of a *positive* ray surface with Z bisecting the *acute* angle between the optic axes; when X bisects this angle the ray surface is said to be negative.

Determining the Optical Properties of Crystals. *The Light Used.*— In general the light used is polarized, as the effects of the crystalline structure upon this are more readily studied. Some of the tests also require the use of monochromatic light, that is of light of one definite wave length, while other tests are made with white light.

Obtaining the Polarized Light.— Although occasionally produced by reflection of common light at a definite angle, or by double refraction and absorption, as in the simple polariscope, known as the tourmaline pincers, the usual method is by sending common light through one of the various forms of «nicols» prisms, the original form of which described by Prof. William Nicol was constructed as follows: A cleavage prism of transparent calcite (Fig. 6) is cut diagonally along the line H H and then the two parts are cemented together with Canada balsam. The end faces are ground off slightly so that an angle of 68 degrees is formed. (See Fig. 6). The ordinary ray *o* with an index of refraction of 1.66 is totally reflected. The extraordinary ray *e* with an index of refraction of 1.54 (practically that of the balsam) passes through the prism with little, if any, change. The plane of vibration of the nicol is assumed to be through the shorter diagonal.

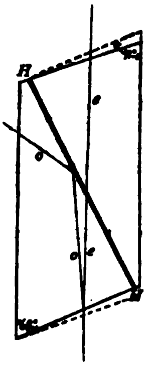

FIG. 6.

The Polarising Microscope.— The various polariscopes of former days have been replaced almost entirely for crystal study by the polarizing microscope the simplest form of which necessarily includes the essentials of an ordinary microscope (a stand supporting a tube carrying objective and ocular, a platform or stage and means of focusing and illuminating), and in addition a nicol, «the polarizer,» below the object, to polarize the incident light, and another above the objective, «the analyzer» arranged to be thrown in or out and «crossed» with respect to the polarizer.

To these essentials may be added many devices and attachments for special purposes.

The tests usually are made in known crystallographic directions, preferably upon «plane parallel» sections or through natural faces at right angles to the desired direction of transmission.

«Crossed Nicols.»—When the vibration directions of the upper and lower nicol are crossed, the polarized light from the lower nicol cannot penetrate the upper nicol and the field is dark. If when a transparent section of a crystal is placed on the stage and revolved, the field is still dark, the direction of transmission is one of *single refraction*, but if during the rotation the field is in general illuminated, but is dark for four positions, 90 degrees apart, then the direction of transmission is one of *double refraction.*

These four positions of darkness or «*Extinction*» occur when the vibration directions of the two polarized rays emerging from the section are parallel to those of the two nicols for then only the polarized light from the lower nicol is transmitted by the section with unchanged vibration direction and cannot pass through the upper nicol.

With crossed nicols and a doubly refracting crystal section the light effect at any point is due to the combined effect of two components with vibrations in the same plane. In general they have been unequally retarded during transmission and may supplement or neutralize each other. If for instance monochromatic light is used and the difference in retardation of the two rays is denoted by Δ and the wave-length of light by λ then:

If $\Delta = \lambda, 2\lambda, 3\lambda, \ldots, n\lambda$ the two components following the same path will oppose and exactly neutralize each other, the light will be stopped and darkness will result for all positions of the crystal section.

Similarly if $\Delta = \frac{1}{2}\lambda, \frac{3}{2}\lambda, \frac{5}{2}\lambda$, etc, the maximum illumination results.

Since Δ increases with the thickness these facts may be shown by use of a thin wedge of a double refracting crystal. Under low magnification this will show with monochromatic light equidistant dark bands with brightest illumination midway between them. When white light is used instead of monochromatic light «*interference colors*» result because for any section Δ may be at the same time: (*a*) approximately a multiple of the wave-length of light of one or more colors, which would, therefore, be shut out: (*b*) closely an odd multiple of the half wave-lengths of other colors leaving these at nearly their full intensity, and (*c*) intermediate, with still other colors.

For any value of Δ there is an absolutely fixed interference color and as these to some extent repeat periodically they are conveniently divided into «orders» the transition color between orders being a sensitive violet so-called because very minute changes in Δ result in decided changes to blue or red. The first, second and third orders end respectively at $\Delta = 575$, 1,130, 1,652 millionths of a millimeter.

Determining the Fact of Single or Double Refraction.— If with crossed nicols and the crystal section on the stage the field remains dark throughout the rotation of the stage the crystal is singly refracting in the direction of transmission. If the field is dark at intervals of 90 degrees and elsewhere illuminated the crystal is doubly refracting.

Determining Indices of Refraction.—Accurate determinations require monochromatic light, constant temperature and, except in isotropic substances, those directions of transmission which yield the *principal* indices. The more used microscopic methods are those of Becke and Van der Kolk both of which involve a comparison with the known indices of liquids.

Becke's method is based upon total reflection at an approximately vertical boundary between two substances and the consequent concentration of light upon the side of the substance with the higher index of refraction. After focussing sharply upon a fragment or grain with an approximately vertical boundary or edge and surrounded by the liquid, the objective is slightly raised, giving the effect of a bright band moving into the denser substance.

Van der Kolk's method is better for irregular fragments and is based upon the behavior of the fragment in obliquely incident light. With proper adjustments approximately lens-shaped fragments become more strongly illuminated on one side or the other according as their indices of refraction are greater or less than that of the surrounding liquid.

Accurate determinations of the principal indices of refraction are often preferably made by the "prism method" involving the measurement of the "angle of least deviation" and of the prismatic angle. Up to a value of about 1.8 they are very conveniently made by the use of refractometers based upon the principle of total reflection, in which the indices of refraction can be rapidly determined upon polished or natural surfaces from a millimeter in diameter up.

In a much used type the surface of contact is the diametral plane of a glass hemisphere of very high index of refraction, the crystal surface is placed on this with a drop of some liquid also of high index. The diffused light from one side is in part totally reflected and the "limit line" found by a telescope. The index is calculated from the angle at which the telescope obtains the adjustment

Determining Birefringence.— The birefringence or strength of double refraction of any doubly refracting crystal is the difference between its maximum and minimum indices of refraction. If these indices can be determined to the third decimal their difference may be taken as the birefringence.

In practice the birefringence is usually determined from the retardation Δ and consequent interference color and the thickness of the section, by the relation $\Delta = t(n_1 - n)$.

The retardation Δ can be measured with great accuracy by compensators. The thickness determination is less accurate.

The function of the compensator, which in its simpler form is a wedge of doubly refracting crystal, is to lower the value of Δ *by known amounts* until $\Delta = 0$.

Determining Extinction Angles.— The angle between an extinction direction and some recognizable crystalline direction, cleavage, crack, edge, twin plane, etc., is called an extinction angle of the section.

The best general method is to carefully determine the position of the crystalline direction, then rotate the stage clockwise until the field is dark at some reading *a*. Continue the rotation until the field is light, then turn back counter clockwise to some reading *a'* where the field is again dark. The reading halfway between is near maximum darkness.

Test plates are also used which between crossed nicols develop some sensitive interference color. This color is not changed when the section being tested is in its extinction position, but is notably changed for any other position.

Determining Pleochroism.—Pleochroism may be determined with the polarizing microscope as follows:

The extinction directions are found and then the upper nicol is pushed out and the colors for the two extinction positions noted and compared. These positions give the maximum difference in color for the direction of transmission. The pleochroism may appear as a change in color or a change in the shade of the same color.

It is sometimes more satisfactory to observe the "twin" colors side by side by use of a dichroscope which in its essentials is a cylindrical casing with a rectangular hole at one end and a lens at the other and between a rhomb of calcite of such a length that the two images of the hole are *just* in contact.

The section is held close to the rectangular hole and the instrument rotated until the two images are alike in color. Midway between two such positions the colors differ most.

Determining Uniaxial or Biaxial by Interference Figures.— By introducing a convergent lens below the stage of the microscope polarized rays are sent through the section in a great number of directions and a simultaneous picture is obtained of the interference phenomena due to the varying structure in all these directions. Usually a high power objective is needed and the so-called interference figure may be seen by removing the eye-piece and looking down the tube or by retaining the eye-piece and using suitable extra lenses.

No interference figure is obtained from any section of an *isotropic* (*isometric*) *crystal.* The field remains dark.

Uniaxial Crystals give their most characteristic interference figure when the section is at right angles to the optic axis. This figure consists of a dark cross, the arms of which, called the "isogyres," intersect in the centre of the field and remain parallel to the vibration directions of the nicols during rotation of the fragments. It is due to those rays which then have their vibration planes parallel to the nicols. As the stage is rotated successive rays come into these positions, maintaining the same effect.

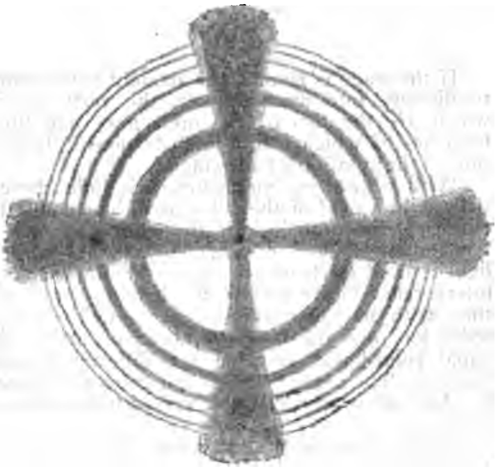

FIG. 7.

With monochromatic light the field will be of the color used, but if the section is not too thin, the centre of the black cross will be surrounded by concentric dark circles, corresponding to rays for which $\Delta = \lambda, 2\lambda, 3\lambda$, etc.

With white light the concentric circles will be color rings, arranged strictly in the order of the interference color.

Biaxial Crystals yield characteristic interference figures both with sections normal to an optic axis and with sections normal to the bisectrics X and Z. In the former the isogyre is a single black bar, essentially straight, when the trace of the plane of the optic axes coincides with the vibration direction of either nicol, but for all other angles of rotation it is curved and resembles one arm of an hyperbola. This arm rotates in the opposite direction to the rotation of the stage.

If the section is not too thin there will be black and often nearly circular interference bands with monochromatic light, and colored curves with white light corresponding to Δ= λ, 2λ, 3λ, etc.

Sections normal to a bisectrix yield an interference figure in which the «isogyres» appear as two dark bars or brushes. For the so-called normal position (Fig. 8) one bar connects the points of emergence of the optic axes, the other is a thicker, lighter band at right angles to the first and midway between the axes.

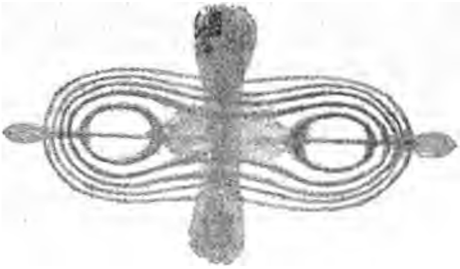

Fig. 8.

If the stage is rotated the straight bars seem to dissolve into an hyperbola, the vertices of which are the loci of the optic axes and the branches of which rotate in the opposite direction to the rotation of the stage.

With convergent monochromatic light there will be, in a field of the color used, black closed curves around the loci of the optic axes corresponding to Δ= λ, 2λ, 3λ, etc. If white light is used isochromatic curves result, but the interference figure may be much more complex than with monochromatic light as neither the axial loci nor the isogyres nor the curves of equal retardation coincide for different wave lengths. The angle between the optic axes may be obtained from the last-described interference figure.

Under favorable conditions interference figures obtained with white light will serve to distinguish between the orthorhombic, monoclinic and triclinic systems, for they conform in shape and distribution of color to the symmetry of the system. With orthorhombic crystals the figure will be symmetrical to the line joining the optic axes, to the line through the centre at right angles thereto and to the central point, with monoclinic crystals the figure will be symmetrical to only one of these and with triclinic crystals to none.

Interference figures furnish a ready means for ascertaining whether the ray surface is positive or negative.

Thermal Properties of Crystals.— Heat rays differ from light rays in their relatively greater length, but may be reflected, refracted, doubly refracted, polarized and absorbed, and it is possible, though difficult, to determine a series of thermal constants for crystals.

Conductivity.— Crystals conduct heat with unequal rapidity in different directions. If a crystal face or cleavage surface is coated with an easily melted wax and touched with the point of a hot wire the wax will melt in a circle with either an *isometric* crystal or a basal section of a hexagonal or tetragonal crystal. All other sections will yield ellipses varying in eccentricity and in position of axes.

Expansion.— When a crystal is uniformly heated, directions crystallographically alike expand in the same proportion, but directions unlike do not. This is shown by the fact that certain interfacial angles are changed, others are not, and the expansion may be accurately measured for any direction, but the methods involve apparatus of great precision and cost.

The Magnetic Properties of Crystals.— All crystals and indeed all substances are to some extent either attracted or repelled when placed in the field of a powerful electromagnet. Those that are attracted are paramagnetic, those repelled, diamagnetic. The strength of the magnetization varies with the direction in crystals, and so far as studied the magnetic relations are analogous to the optical relations with the curious exception that the isometric crystals of magnetite are not magnetically isotropic, but show different magnetic intensity in different directions.

Electrical Properties of Crystals.—*Electric waves* are like light waves; they travel with the same velocity, exhibit the phenomena of reflection, refraction and polarization and differ only in much greater length. Bose has described an electric polariscope, with which it may be possible to test opaque crystals as we now test transparent crystals.

Electric Conductivity.— In the few tested crystals there has been found a dependence of electric conductivity upon crystallographic direction, conforming to the thermal conductivity.

Pyroelectricity.—Change of temperature will develop electric charges in certain classes of crystals. Usually the crystal is heated and allowed to cool. During the cooling of the crystal positive charges collect at the so-called *antilogue* pole and the negative charges at the *analogue* pole.

Piezoelectricity.— Similar charges are developed by pressure, for instance tourmaline compressed in the direction of the vertical axis develops a positive charge at the antilogue end and a negative charge at the analogue end, or precisely the charges which would result from cooling a heated crystal.

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PHYSICAL CULTURE. See PHYSICAL TRAINING.

PHYSICAL ECONOMICS. See ECONOMIC VALUE OF MAN AND THE MEASUREMENT OF DAMAGES FROM INJURY OR DISEASE.

PHYSICAL EDUCATION. See HEALTH EDUCATION.

PHYSICAL GEOGRAPHY. See PHYSIOGRAPHY; GEOGRAPHY.

PHYSICAL OPTICS. See LIGHT.

PHYSICAL SOCIETY, American, a society affiliated with the American Association for the Advancement of Science (q.v.). It was founded in New York, 20 May 1899. From that date to June 1902 it published quarterly a ‹Bulletin.› After that the proceedings of the society and the papers read at its meetings were published in *The Physical Review,* a monthly founded in 1893 and published with the assistance of Cornell University at Lancaster, Pa., and Ithaca, N. Y. In January 1913 this publication was taken over by the society and is now managed by an editorial board appointed by the latter. The society has no definitely established headquarters, but holds frequent meetings in various parts of the United States for the reading and discussion of papers on the subject of physics.

PHYSICAL SOCIETY OF LONDON, The, a learned organization established on 14 Feb. 1874, having for its object the advancement of a knowledge of physics. The society publishes ‹Proceedings› bi-monthly from December to August. Its headquarters are at the Imperial College of Science and Technology, London.

PHYSICAL TRAINING, a term used to indicate the systematic development and maintenance of bodily power and health. In the broad sense it includes gymnastic and athletic exercise, active sports, personal, public and school hygiene. While the term is often used in its broad sense as health training, this article has special reference to physical exercise as related to this.

Systematic training of the body has been followed in some form by probably every nation and race, savage and civilized. In the past it has taken the varied forms of training for warfare through exercise for developing endurance, strength and skill; recreative and competitive sports; gymnastic dances for religious, martial or recreative purposes, and remedial exercises for the cure of disease, often associated with religion and administered by the priesthood. The highest development in many ways that the subject has ever known was in ancient Greece, where athletic games held a place in the political, religious, intellectual and artistic life of the country that made them one of the greatest human institutions in history. (See ATHLETICS; GAMES). The physical training of women in ancient Greece consisted mostly of dancing and ball-playing, though the women of Sparta were not allowed to marry until they had given a public exhibition of proficiency in gymnastics. After its decline in Greece physical training next arose to the dignity of an institution in the age of chivalry when physical strength and prowess were again apotheosized for noble uses. (See GAMES). Following this, development of the body fell under the ban of an ascetic age, where it remained until early in the 19th century despite the protests of such philosophers and reformers as Rabelais, Montaigne, Rousseau, Pestalozzi, Luther, Milton and Locke. At the time mentioned began a renaissance of physical training out of which has grown, side by side with the continuance of athletic sports, the modern gymnasium, a wholly unique institution in its construction, equipment, and the kinds of exercise adapted to it. This exercise includes gymnastics proper, with and without apparatus, games, gymnastic and folk dancing and athletics. With the growth of cities, massing large numbers of people in limited space and curtailing facilities for outdoor exercise, the gynasium has come to mean, not only a preparation for competitive sports, but for thousands of people the only opportunity for vigorous, all-over bodily exercise. At the same time there has developed a scientific and educational understanding and application of the subject in marked contrast to earlier methods. Exercise in its early forms, as inspired by considerations of religion, warfare or competitive sport, was used with a purely empirical knowledge of its effects. With the development of physiology, psychology and related sciences, has come a closer analysis and classification of exercises for their effects upon the physiological functions, a clearer knowledge of the relation of exercise to psychological and moral development, its adaptation to individual needs, and its use as an instrument of education. Germany and Sweden were pioneers in this modern advance of the subject, and the principles and methods there developed have had a profound influence upon the physical training of other European countries and America.

German gymnastics have been developed in societies organized into the Turnerbund, which is the largest organization for gymnastic purposes that the world has ever known. It was founded about 1810 by Friedrich Ludwig Jahn (1778–1852), who invented the mode of exercise known as turning, and who is called the Father of German Gymnastics. The inspiring expressed motive for Jahn's work was patriotism — the development of strong men for the «protection of the fatherland.» No institution of physical training since the days of ancient Greece has had such a popular following as the German Turnerbund. Indeed, it bears strong analogies to the Greek institution. Among these is the combination of intellectual, artistic and social interests with physical training. For children there are, in many Turnvereine, classes in drawing, modeling, needlework and literature. The adults have debating societies and choral and dramatic clubs. The social element is very strong. In both Germany and the United States the German turners have a meet or festival every four years, when thousands of participants from all parts of the country contest for honors in gymnastics, athletics, debating, singing, etc. Prizes of laurel or oak leaves, or diplomas, are awarded for these contests. Jahn and his pupils, building upon a collection of exercises made by Gutsmuths (1759–1839) invented a number of pieces of apparatus and exercises to be performed upon them. Much of this German work calls for the sustaining of the weight of the body upon the arms, as in using the horizontal and parallel bars, traveling and flying rings. The vaulting horse and buck, balance boards, ladders and climbing poles are also prominent in German gymnastics. Freehand gymnastics (namely, without apparatus) and work with light, movable apparatus, such as wands, dumb-bells and Indian clubs, were developed and adapted to schools by Adolph Spiess (1810-58). The establishment of gymnasiums for secondary schools was decreed by the Prussian government in 1844, and for elementary schools for the people in 1860. The Royal Central Gymnastic Institute for training teachers of gymnastics for the army and the schools, was established by the government in 1877. Technically, as introduced in the United States, German gymnastics partake of the empirical character of earlier forms of exercise. The work is classified as tactics, calisthenics, fancy steps, apparatus work, popular gymnastics, games and plays. Within these divisions further classification is according to external features, as, exercise on the upper side of the ladder, on the lower side, outer side, etc. The progressive arrangement of exercises is according to neuro-muscular skill, advancing from simple to complex movements. The capacity of pupils is also determined on the general lines indicated by their separation into classes of children, men, women and old men. Almost all possible movements are permissible, and the ingenuity of teachers has resulted in a large variety of exercises. Indeed, interest and enjoyment — work under the guise of youthful happiness and sport — mark the general spirit of the turner gymnastics. Games for both adults and children are a prominent feature, and for women and children, figure marching with dance steps and singing, called roundels or reigen. The method of teaching and conducting work is almost invariably imitative, the pupils' movements being largely reflex and automatic. This, with the use of apparatus, gives an objective trend to the mental attitude of pupils which reduces mental tension to a minimum. The musical genius of the German people is manifest in its gymnastics, not only in the frequent use of musical accompaniment, or, in the absence of music, of inspiring rhythms beaten out by the instructor, but, in a larger sense, in the artistic arrangement of drills or series of exercises. These are often constructed around a given exercise which serves as a theme on which variations are arranged, working up, as it were, to a climax, and returning at the close of the series to the initial movements. This artistic bent shows in *ensemble* effects used for their appeal to the eye, as when alternate lines work in opposite directions, or a program is closed with a tableau or pyramid of performers.

Gymnastics in Sweden are also "the lengthened shadow of one man"— Peter Henry Ling (1776-1839). While never attracting a popular following like German gymnastics, those of Sweden are also under government auspices and are universally used in the schools and the army, while since 1814 a Royal Gymnastic Central Institute for the training of teachers has been maintained at Stockholm by the government. Ling put gymnastics into pedagogical, military, medical and æsthetic divisions. He brought the subject within the scientific trend of the century by a careful study of the effects upon the body of various positions and exercises, and their classification according to these effects. Developments in physiology have modified some of Ling's conclusions, but the underlying principles remain. He invented a number of pieces of fixed apparatus, notably the stall bars, Swedish horizontal bar (boom) and vaulting box. These pieces of apparatus admit of less freedom and variety of motion than the German apparatus, but lend themselves to more closely graded mechanical progression in the exercises. No light, movable, or so-called calisthenic, apparatus is used in the Swedish work, but much is made of free-hand gymnastics. All exercises are carefully selected for their effects upon the physiological functions or bodily posture. The latter is especially emphasized. No exercises are admitted which even temporarily constrict the chest, embarrass the respiration or "produce continuous pressure upon the large vascular or nerve trunks." Static contraction of the muscles is much used, however, in holding one part of the body in a given position (as bending the trunk forward) while another part (as the head or arms) is exercised. All Swedish gymnastics are taken to command, music being entirely eschewed. These commands are extremely analytical, practically nothing being left to the initiative of the pupil or to the sub-conscious processes of muscular co-ordination. Many Swedish instructors teach new exercises entirely from command or verbal description as distinguished from imitative methods of presentation.

As introduced in the United States Swedish gymnastics have been characterized by an arbitrary and minute classification of exercises and the arrangement of these in a "day's order" or lesson, as follows (Posse): (1) introductions, (2) archflexions, (3) heave movements, (4) balance movements, (5) shoulder blade movements, (6) abdominal exercises, (7) lateral trunk movements, (8) slow leg movements, (9) jumping and vaulting, (10) respiratory exercises. The idea of orderly progression in the use of exercises with regard to their physiological and mechanical difficulty is one of the most valuable contributions made to modern gymnastic practice. For instance, the effect upon circulation and respiration of exercise of the large muscular groups, as of the thigh and trunk, is much greater than of small groups, as of the arms or legs, and within reasonable limits this effect is intensified by overcoming resistance as in lifting the weight of the body in jumping or other precipitant exercises. Exercises for these muscular groups therefore bear a logical relation to one another. Muscular strength is similarly amenable to progressive development through the application of some of the laws of mechanics. For instance, work of the trunk muscles is increased by altering the leverage through positions of the arms, and balance exercises are made more difficult by narrowing the base and shifting the centre of gravity. The Swedish medical gymnastics, especially in orthopedic practice and in the form of massage, are widely used.

Physical training in the United States received its first popular impetus from Dr. Dio Lewis, about 1860. Dr. Lewis was not a scientific worker, but aiming to put the spirit of sport and play into gymnastics promulgated some good all-over exercise in free-hand movements and with dumb-bells, wands, Indian clubs, bean bags and some apparatus of his own devising — the "shoulder pusher" and "iron crown." This work had an extended vogue throughout the country with both men and women, and was introduced into many schools. Since the Civil War, and especially in the last 10 years of the 19th century and the early 20th century, physical training has undergone a steady advancement in the United States, both in the extent to which it is used, and in the development of the subject itself.

In 1870 and later Dr. Dudley A. Sargent invented a series of pulley weight machines, some 40 in number, which have since held a prominent place in gymnastic equipment. The best known of these is the chest weight machine. By means of these appliances exercise may be localized to given groups of muscles, thus developing weak or undeveloped parts of the body. Obviously measurement and general physical examination of pupils is an important factor in the thorough use of such a method.

In 1887–88 there swept over the country a popular fad for what was called the Delsarte system. François Delsarte (1811–71) was a native of France, whose work to establish laws of expression for the dramatic art probably led to the origination of certain forms of free-hand exercise, æsthetic in character, which have been developed by a number of American workers, though his daughter has expressly denied that he had anything to do with gymnastics. His work was approached entirely from a philosophical, as distinguished from a physiological, view point, and the mystic number three and its multiples governed the various modes of movement and expression. That every movement and attitude of the body should express an emotion was a cardinal point. The cause of physical training was for a time retarded by the sentimental, languid and unscientific atmosphere which surrounded much of this work, but with the passing of the vogue it is found to have left two distinct types of exercise and certain principles of graceful motion which have permanent value. To make the body flexible, and to free it from habits of muscular tension, relaxing (devitalizing) exercises are used. These consist in making absolutely limp one part of the body after another, and finally the whole at once, by removing all tension from the articulations. These exercises are followed by a series of energizing or vitalizing movements, slow and rhythmic. Principles of grace embodied in these include the slow evolution of movement from one point to the next, and the movement in opposition (opposite directions) of two parts moving simultaneously. Delsarte's expressional work is highly valued in dramatic training.

Swedish educational gymnastics were introduced into this country in 1888 by Baron Nils Posse, having been preceded many years by German gymnastics. These two schools or methods of work, differing radically, were each introduced with the handicap of the term "system," implying fixed limits and arbitrary modes of procedure, as distinguished from flexible methods, capable of growth and adaptation, though each claimed the latter quality. A bitter rivalry ensued, extending over many years and hindering the development of the subject. This warring of systems has largely given place to a broader spirit which recognizes the fact that different methods of gymnastic procedure are fitted to produce different results suited to different conditions and temperaments. Certain principles have emerged which, in a more flexible guise than when first introduced to us, are more largely entering into all gymnastic work and may be said to serve as criteria of its quality. These principles include a careful consideration of the condition and needs of the individual, a purposeful selection of exercise with regard to its effects, a general, though not of necessity an uninterrupted, progression in its use, all-over body exercise in a given lesson, and its arrangement with reference to curves of effort — that is, the gradual approach to, and receding from, maximal heart effects. Awkward performance is giving way to the good form or finished execution that denotes definite training of the power of muscular co-ordination; cultivation of erect carriage and generally good posture are recognized as indispensable. Methods of teaching gymnastics are found to be as amenable to the laws of pedagogy as any other branch worthy to rank in the science of education, and recognition is given to the training or use of psychological powers — the motor sense, the will, objective and subjective interest, automatic and voluntary attention, etc. Indeed, physiological psychology and child study have contributed as much to physical training as has the physiological laboratory.

The professional training of teachers of gymnastics has done much to advance the cause of the subject which long suffered from the idea that agility of performance was a sufficient qualification for teaching. There are in the United States many normal schools of physical training, offering courses from two to four years in length, including several universities and colleges that give normal instruction in the theory and practice of the subject. In addition many normal schools for class teachers train their students to conduct class exercises in various branches of physical training. There are also each year many summer schools of physical training. The subjects studied in normal schools of physical training include physics, chemistry, histology, physiology, anatomy, kinesiology, anthropometry, biology, symptomology, psychology, pedagogy; personal, public and school hygiene, besides the various kinds of practice work in gymnastics, athletics, swimming and other sports, fencing, games, dancing, voice training and practice teaching.

The modern gymnasium requires expert knowledge for its design and construction. From 30 to 40 square feet of floor space should be allowed for each pupil exercising in a class. Trusses or ceiling beams should clear the floor 20 feet and a gallery for a running track should be 10 or 11 feet clear from the floor. Lockers, swimming tank, office and examining room for the director should be included.

Anthropometry, as used in connection with physical training, consists mainly of the measurement of significant girths with a steel tape; depths, as of chest and abdomen, with calipers; standing and sitting heights with the stadiometer; strength tests of the various muscular groups with dynamometers, etc.; the measurement of lung capacity with the spirometer and the taking of weight. The testing of sight and hearing, and psychological tests for reaction, time, etc., are often included. To these are added examination of the heart, lungs, spine, etc., and a tabulation of facts of personal history bearing upon heredity and other significant influences. Such examination is made by the physical directors of practically all colleges and universities, secondary and normal schools and young men's Christian associations. From this data an individual may be compared with the mean, average or normal type for his age and height, exercise prescribed according to his needs and development noted from time to time. Physical examination of children in the public elementary schools is rapidly becoming an established feature, and many States have laws requiring such regular examinations and systematic physical training for children of school age. Out of this there is evolving a more scientific correlation between the laws of growth and physical exercise. These laws have been largely formulated on the classic studies first made by a commission in Sweden, and in the United States by Dr. W. T. Porter in Saint Louis and Dr. H. P. Bowditch in Boston. From these measurements have come a recognition of growth periods and laws of growth that form a valuable index to required exercise.

The representative organization of physical training in the United States is the American Physical Education Association (formerly The American Association for the Advancement of Physical Education), organized in 1885. The ‹Proceedings› of this association and its official organ, ‹*The American Physical Educational Review*› published since 1896, form the most valuable depository in English of the scientific and philosophical material on the subject.

Other organizations of national scope should be mentioned, each of which is devoted to a special phase of physical development. Athletics and sports have been mainly fostered by the Amateur Athletic Union, the National Collegiate Athletic Association, The Intercollegiate Association of Amateur Athletes of America, The Young Men's Christian Association Athletic League and Public Schools Athletic Leagues for Boys and Girls. These athletic organizations govern amateur standards and awards, are more or less concerned with arrangements for competitive games and meets, furnish officials for these and are usually represented on the rules committees for various games. The Playground and Recreation Association of America, organized in 1904, has secured children's playgrounds for many communities throughout the country, and has furthered all kinds of recreation for children and adults, including leadership in war camp community service during the World War. This organization has been a large factor in wide recognition of play as a factor in social economics and for its educational values, physical, mental and moral. The American Posture League, founded in 1914, has done much practical work in gaining recognition of habitual body posture as a fundamental feature of sound physical development and health. Its educational work has included the promulgation of a standardized or «Triple Test» for posture that has furnished means of measuring educational results in this particular. The main work of the society, however, has been to improve the environment as it affects posture, by fashioning in correct anatomic form many articles of every-day use that mold the posture of the body — a scientific work engaging in the league's technical committees, orthopœdic surgeons, school hygienists, etc., and resulting in the standardization of school and other furniture, shoes, corsets, waists, coats, hose supporters and other articles. The Life Extension Institute, founded in 1915, is also unique as an organization in the field of public health and preventive medicine. It undertakes, by standardized periodic examinations, to discover incipient or developed pathological conditions and so forestall illness. These examinations are made by contract with industrial organizations for their employees, or for individuals on annual membership or otherwise. In the examination of many thousands of industrial and office workers the Life Extension Institute has found that from 50 per cent to 59 per cent have impairments of arteries, kidneys, heart or other organs that indicate breakdown if not taken promptly in hand and remedied. The army draft, with its rejection of 40 per cent on grounds of physical defects, and the Marine Corps rejection of 90 per cent startled the country into realization of the need for better physical development for children, better living and working conditions for adults and better personal hygiene for all.

In 1918 there were in the United States of America 57 societies engaged in public health work. Twenty-eight of these were devoted to such work exclusively and 29 of them supplemented their main work of social or educational betterment with some activity in preventive medicine. Among the many other indications of a vast movement among the more intelligent public to improve health and development and forestall illness may be mentioned the great health engineering work of the Rockefeller Foundation through its medical board, of the Russell Sage Foundation, enormous private bequests to medical research, the improvement of health conditions and the wiping out of specific diseases in whole districts, as in New Orleans, Cuba and the Panama Canal Zone. Much of this has been the work of the Federal government through the surgeon-general's office and its other agencies (segregated in 1918 under the United States Public Health Service). The community surveys and coöperative work of all health agencies in the great experimental studies in Framingham, Mass., Jackson, Mich., and Cincinnati, Ohio; the anti-tuberculosis crusade; the attention to school and industrial luncheons; the attention to nutrition, food values and wholesome food for the masses preceding, during and after the war — these are all parts of the great movement for improved health standards.

All of these health agencies recognize physical exercise as a fundamental requisite to any health program. Conversely, systematic work in physical exercise, to produce its best results, should be related to other health considerations and preceded by thorough physical examination. It has been estimated (New York City Department of Health, 1916) that out of any 1,000 industrial workers 25 are all the time absent for illness. The United States Health Service has estimated the annual economic loss from illness among industrial workers in this country at $750,000,000. The future of the nation in its economic power and in the strength and character of its population, is thus inherent in this subject of physical development.

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PHYSICIAN, one who practises or is skilled in the art of healing and in methods of preserving and promoting health, especially one who prescribes remedies for diseases; specifically, one who is legally authorized to practise medicine. In the United States physicians qualify by compliance with State requirements. State examinations for ascertaining the fitness of candidates for this calling are now generally held, and to those who successfully pass them license to practise is granted. Usually a physician is not bound to attend any person who may call him; but having undertaken to treat a patient, he is liable to the penalties of malpractice in case of injury resulting from his own incompetence or neglect. As between physician and patient, relations are privileged and confidential, and a patient's secrets in the keeping of a physician are inviolable, the State not even requiring them to be made known in legal procedures. The relations of physicians to the legal fraternity and to the legal transactions of the State form part of the subject of medical jurisprudence (q.v.). Consult Mitchell, S. Weir, 'The Physician, a Poem' (Boston 1900); Moll, A., 'Aerztliche Ethik' (Stuttgart 1902); Mumford, J. G., 'A Narrative of Medicine in America' (Philadelphia 1903); Schweninger, E., 'Der Arzt' (in *Die Gesellschaft*, Vol. VII, Frankfort on Main 1906); Taylor, A. N., 'The Law in its Relation to Physicians' (New York 1900).

PHYSICIANS, Royal College of, Edinburgh, incorporated 26 Nov. 1681 by royal charter; a body empowered to make laws for promoting and regulating the practice of medicine within the city of Edinburgh, town of Leith, and districts of the Canongate, West Port, Pleasance and Potterrow. No person was to be allowed to practise medicine within these limits without a license or diploma from the college, and all medicines sold within the same limits were made liable to be inspected by the officers of the college, together with a magistrate and chemist, who were authorized to destroy all medicines which were found bad or unwholesome. No apothecary was allowed to open a shop until he had passed an examination before the president and censors of the college. Its Fellows were freed from jury duty. Many of the rights and practices of the college gradually fell into abeyance, due to the changes in customs brought about as time passed. A warrant from the college is no longer necessary to a practitioner; but the body is now represented in the general medical council established by the Medical Act of 1858. A new charter was granted to the college by Queen Victoria on 16 Aug. 1861, under which the institution operates at the present time. In connection with the college there is a library, founded in 1683, and a museum of materia medica, begun in 1835. The college, since 1846, is located in its own building in Queen street. Consult 'Historical Sketch and Laws of the Royal College of Physicians of Edinburgh, 1681–1882' (Edinburgh 1882).

PHYSICIANS, Royal College of, London, a body whose organization dates from 1518. In that year Thomas Linacre, the celebrated scholar and humanist, one of the physicians of Henry VIII, obtained from him, with the aid of Cardinal Wolsey, letters patent dated 23 Sept. 1518 and incorporating all men of the medical faculty in London as one body. Various privileges were accorded to them, chiefly that of prohibiting any one from practising as a physician in London, or within seven miles of it, unless he had first obtained a license from this corporation. A charter granted four years later confirmed the privileges of the body, except that graduates of Oxford and Cambridge were permitted to practise within the jurisdiction of the college without previously being examined by it. Various charters have been since granted to the college, but from the passing of the Medical Act of 1858 its license has not been necessary to those practising in London or within seven miles around. At present the corporation consists of a president, fellows and members. It occupies a building in Pall Mall East, opened in 1825. Consult Garth, Sir S., 'The Dispensary, a Poem' (London n. d.); Munk, W., 'The Roll of the Royal College of Physicians of London, 1518–1825' (3 vols., London 1878).

PHYSICIANS' LIABILITY INSURANCE. See Accident Insurance.

PHYSICK, fiz'ĭk, Philip Syng, American surgeon: b. Philadelphia, 7 July 1768; d. there, 15 Dec. 1837. His father, Edmund Physick, was an Englishman and, previous to the outbreak of the revolution, Keeper of the Great Seal of Pennsylvania. Philip Syng Physick was graduated from the College of the University of Pennsylvania in 1785, studied medicine under Dr. Adam Kuhn, a well-known Philadelphia practitioner and pupil of Linnæus and at the University of Pennsylvania. In 1789 he accompanied his father to England where he continued his medical studies under Drs. Hunter, Clark and Osborne. In January 1790 he was appointed for one year to the position of house surgeon at Saint George's Hospital, London. In January 1791, at the expiration of his term at the hospital, he received his diploma from the Royal College of Surgeons in London. Shortly after that he went to Edinburgh where he continued his medical studies until May 1792 when he received the degree of M.D. from the University of Edinburgh. He returned to Philadelphia in 1792 and began practice. In

1793 he did valuable service during a severe epidemic of yellow fever as the physician of a special hospital established by the board of health. He himself suffered a severe attack, but recovered. His fame as a highly skilled and successful surgeon spread rapidly. As early as 1794 he was elected one of the surgeons of the Pennsylvania Hospital, Philadelphia, where he performed many hitherto more or less unknown operations. During his career he also developed a number of surgical instruments to such a point of perfection that some of them are still used to-day in accordance with his plans. During the repeated yellow fever epidemics of 1797, 1798 and 1799, he was again so active that he suffered a second attack from which he recovered only after a severe illness. In 1805 he was appointed professor of surgery at the University of Pennsylvania and in 1819 became professor of anatomy there, which post he held till 1831. In 1824 he was elected president of the Philadelphia Medical Society, continuing as such until his death. In 1825 he was made a member of the Royal Academy of Medicine of France and in 1836 an honorary fellow of the Royal Medical and Chirurgical Society of London. He has been styled «the father of American Surgery.» Consult Bell, John, ‹Philip Syng Physick› (in ‹Lives of Eminent American Physicians and Surgeons› ed. by Gross, S. D., Philadelphia 1861); Randolph, J., ‹A Memoir on the Life and Character of Philip Syng Physick› (Philadelphia 1839).

PHYSICS may be defined as the science of *energy*, of the transformations of energy and of its relation to *matter*. This is an imperfect definition in that, first, a comprehensive understanding of the meaning of *energy* involves a complete knowledge of physics; and second, the science of energy, in its broadest sense, comprehends all science, while the content of physics is generally limited to the scope of the topics which will be outlined below. Indeed, in its earlier history and under its early title of natural philosophy, physics did encompass a much wider scope; but by a process of exclusion of certain branches as they developed into specialized sciences, such as chemistry, astronomy, metallurgy, meteorology and geology, it has been limited to its present scope; and about 1870 its present name of physics took the place of the older title. This process of separation is still going on: as, for example, certain parts of electricity, that have heretofore belonged to physics, are gradually being developed into the separate *science* of electrical engineering, as distinguished from the practice or art of electrical engineering. At the same time, investigation and discovery are adding new fields to the science of physics. In its applications and its inter-relationships, physics lies at the foundation of *all* of the experimental sciences and still assists their modern development, to a lesser extent only than does mathematics. Thus the interconnections between physics and the other sciences, particularly chemistry, are so intimate that it is impossible to draw an exact line of separation, so that in these borderlands between the sciences have been built up new sciences which partake of the nature of both and which have consequently been named physical chemistry or chemical physics, meteorological physics, physical astronomy or astro-physics, etc.

Modern physics is an inductive science. Like the other sciences, it is based upon a belief in the «constancy of nature»; upon the belief that the same cause, operating under the same conditions, will result in the same effects at any time. In order to ascertain the causal relations of physical occurrences, or phenomena, observations are made of what conditions seem to affect the phenomenon under study and experiments are performed in which the conditions are under the control of the observer, so that they may be varied separately, in order to determine which conditions are essential and which are accidental. Then exact measurements are made to determine the quantitative relation between the essential conditions and the effect resulting. This quantitative relation, rigidly established by exhaustive experiments and with its limitations clearly specified, is known as a physical *law*. For example, it is found that for a constant mass of gas, at a constant temperature, the product of its pressure by its corresponding volume is a constant for most gases within a moderate range of pressures; and this relation is known as Boyle's Law. It may be called an empirical law, in that it represents a relationship between two physical quantities, the explanation of which it does not give. A study of many similar or related phenomena suggests a generalization or *hypothesis* as the explanation of them all. This hypothesis, tested, modified and perfected by extensive study and experimentation along lines suggested by it and extending to all known phenomena to which it may have any relation and strengthened by its use in suggesting and predicting new phenomena, becomes a physical *theory* and may later attain to the dignity of a general physical law. Thus a further study of the relations between the pressure and volume of a gas and the other factors (temperature, chemical structure, etc.) which might be related to it, led to the kinetic hypothesis of gases and this hypothesis, suitably modified, having been found to be in agreement with the phenomena it was called upon to explain and to be still further supported by other phenomena (such as, for example, the Brownian movements) has become the kinetic or dynamic theory of gases.

Physics, as the science of energy, has its unification in the principle of the conservation of energy. The statement of this, in the words of Maxwell, is: «The total energy of any material system is a quantity which can neither be increased nor diminished by any action between the parts of the system, though it may be transformed into any of the forms of which energy is susceptible.» The importance of this principle and its influence in unifying and in developing physics cannot be overestimated. Just as the development of the principle of conservation of matter unified chemistry and put into the hands of the chemist a rule for measuring his facts and for checking his theories, so the principle of conservation of energy has become the basic law connecting all physical phenomena, for testing the accuracy of physical experiments and for checking, modifying and extending physical theory. Obviously, a great deal depends upon our definition of energy and the great importance of the conservation principle lies in the fact that there is so simply definable a physical function as mechanical energy which does remain invariant in a «closed» system; and furthermore, that it is possible to express quantitatively all other physical manifestations of nature in terms of this invariant energy function. In the paragraphs which follow, attempt is made to outline the content of physics as it exists at the present writing. It should be again emphasized here that this content cannot be fixed for all time; that it is changing, undergoing development, essentially dynamic in its nature. It is at present generally divided into the following topics, or similar ones: mechanics and (mechanical) properties of matter («pure» and «physical» mechanics), sound, heat, light and magnetism and electricity. This division is to a great extent arbitrary, made for convenience in study and the modern science is careful to recognize it as such and to recognize the unity of relationship among all its parts.

Mechanics (or «pure» mechanics) is essentially a branch of mathematics, based on certain axioms derived from physics, but its basic importance in all branches of physical science makes it one of the first topics included in a study of physics. It is that branch of science which deals with motion, with forces, with matter in so far as it is affected by motion and forces i.e., mass and configuration, and with their inter-relations. It is generally divided into kinematics, which deals with motion by itself; and dynamics, of which statics deals with forces alone, under conditions of balance, or equilibrium, and kinetics deals with matter in motion, as the result of the action of forces, and with forces as producing motion. Hydrostatics and hydraulics should be mentioned as important branches or extensions of this part of the science, although often included in the next topic.

Properties of matter («physical» mechanics) comprises the general mechanical properties of matter in each of its three physical states—solid, liquid and gaseous, and the laws that express the causal relations found to exist among them. It includes also all of the distinctive data and physical constants obtained by experimentation with different kinds of material. Density, gravitation, buoyancy, gas laws, elasticity, viscosity, diffusion, osmosis and surface tension are some of the important sub-topics of this subject. Other divisions of the subject are often made, in order to present some particular phase or view-point: as, for example, division into «mass» mechanics and «molecular» mechanics.

Although wave motion is, in its mathematical development, properly a branch of «pure» mechanics, it is generally included with, or placed just before, the subject of sound, since in sound waves and in the vibrations of sounding bodies (stretched strings, rods, bells, air columns, etc.), there exist the most perfect and tangible examples of such motion. And, aside from a study of the physical characteristics of audible sounds, particularly musical sounds and their physical relations in the musical scale and in musical composition, and quite recently, vowel sounds and other sounds occurring in articulate speech, the study of sound is the study of a typical wave motion, whose characteristics (reflection, refraction, interference, etc.), may be easily demonstrated on a convenient scale. The practical importance of the applications of the physics of sound, in the design of sound-producing and reproducing instruments, and in the design of auditoriums and similar public halls, has attained to considerable recognition and emphasis in recent years. Descriptions of the mode of production of vocal sounds, and of the mechanism of audition, is usually included in a general treatise on physics, although they now more properly belong to the respective domains of physiology and of the new (experimental) psychology.

The sub-topics of heat, given in the usual order, are thermometry, thermal expansion, calorimetry, change of state, transference of heat and thermodynamics. Thermometry covers the usual empiric methods of temperature measurement; the idea of the Kelvin or thermodynamic (absolute) temperature scale is left to the proper section of thermodynamics. Thermal expansion includes the experimental determination of the empirical relations existing between physical dimension and temperature for different materials, and the principles and constants thus determined are of considerable importance to the design of all kinds of machinery and construction, and are of vital importance in physical mensuration and chronometry.

Calorimetry and changes of state deal with measurements of quantities of heat. Although arbitrary units of heat quantity (calory, British thermal unit, etc.), are most frequently used, the establishment by Joule and others of the exact equivalence between heat quantity and mechanical energy has made the use of energy units (erg, joule, etc.), increasingly more common. The experimental work consists largely in the determination of specific heats (latent), heats of changes of state (fusion, vaporization, etc.), and of solution, combustion, etc.; and in the study of the physical phenomena which accompany change of state, such as change of volume, of specific heat, of color, etc., and of the effects of all the possible external factors which may affect or change the conditions of change of state. The values of these physical quantities and relationship for the pure elements and for their compounds has assumed such importance in chemical theory and practice that their determination has become an important part of the borderland science, physical chemistry. The study of change of state has made valuable use of thermodynamic reasoning, and among the important developments resulting in recent years should be mentioned the obtainment of nearly all of the normally gaseous elements and compounds in liquid form, and in many cases in sold form and the production of extremely low temperatures by their means. Transfer of heat may be accomplished by three different methods — conduction, convection and radiation: the first two methods depend for their operation upon intervening material media and are properly a transfer of heat energy as such; while the third is a type of electro-magnetic radiation, and is more completely treated under that heading.

Thermodynamics, as the name implies, is involved whenever there is a transfer into heat energy of any other form of energy, or vice versa; and for the investigation and study of such phenomena there have been developed certain general relationships, theorems and methods of treatment, which, taken together in their proper arrangement, form a peculiar and distinct mathematical branch of science which we may designate as «formal» thermodynamics, to distinguish it from the broader field of general thermodynamics. The applications of this thermodynamic reasoning are found in every branch of physical and chemical theory, including electrical, electro-chemical and radiation theory.

The best-known of the relationships of «formal» thermodynamics are the Carnot theorem and the Kelvin or thermodynamic temperature scale. The latter furnishes a temperature standard which is independent of the physical properties of any physical substance, while the two together not only furnish a criterion for the efficient performance of any heat engine (steam, gas, etc.), the purpose for which they were originally developed, but are also the basis of relationships connecting the factors involved in change of state (e.g., the Clapeyron-Clausius equation), thermo-electricity, solution and innumerable other physical and physico-chemical phenomena. Certain special thermodynamic functions such as entropy, which is the common one, have been formulated to simplify the mathematical treatment of these problems. General thermodynamics includes, in addition to the reasoning of «formal» thermodynamics and the applications mentioned above, a thorough study of the relations connecting the mechanical and thermal conditions of matter in the different states, and in the transition states: such as, for example, the relation of pressure and specific volume to the temperature, specific heats, heat of transformation, etc., and their interpretation according to thermodynamic reasoning. The idea of a «perfect» gas, and the evolution of the kinetic or dynamic (molecular) theory of gases, are logical developments of this section of physics. In recent years the methods of «statistical» mechanics which have been developed for the study of certain types of thermodynamic problems have met with considerable success in the study of the «dynamic» theory and of radiation theory. The many applications of thermodynamic theory and reasoning in heat-power engineering, physical chemistry and other fields, might properly be classed as applied or technical thermodynamics.

Light is a form of radiant energy capable of stimulating the nerve termini of the retina of the human eye. Two well-defined methods of study are generally recognized. To a limited extent, its phenomena may be studied, and simple laws for its reflection and refraction by mirrors, prisms and lenses be deduced, without reference to the physical nature of light energy, or of its propagation. This is the method of geometrical optics, as distinguished from physical optics; and it suffices for the design of cameras, telescopes, surveying instruments, range finders, etc., and for most of the work of perfecting the optical surfaces of the lenses used in such instruments (to make them achromatic, anastigmatic, aplanatic, etc.), although intelligent work in this field is now guided by a knowledge of many of the phenomena which come within the scope of physical optics. In physical optics, the phenomena of light are studied for the purpose of determining the nature of light energy and of its propagation, and of its relation to other forms of energy. Lately this has extended to the study of the nature of the bodies that produce light, and as well, of those that reflect, refract or otherwise modify its character or propagation. Study of the phenomena of interference, of diffraction, of transmission in finite time, and of polarization, established the theory (the wave theory) that light energy is propagated through space as a transverse wave motion at a finite, though incredibly high, velocity. Spectral color is identified with wave length. Later investigations have identified light radiation as that part of electro-magnetic radiation whose wave lengths are capable of exciting the visual sense. The wave theory of light gives a clear and logical explanation of all of the phenomena of reflection and refraction, and in addition, has disclosed physical limitations to the clearness of the optical images produced thereby, other than the limitations to the perfection of the optical surfaces, the knowledge of which has done much toward the perfection of such optical instruments. Furthermore, the development of apparatus for the demonstration and study of the phenomena peculiar to physical optics has resulted in the invention of many new and valuable physical instruments — interferometers, diffraction gratings, polarimeters, etc.— which open up new fields of knowledge and study, and permit of the measurement of many physical quantities, both new and old, to a previously unheard-of degree of accuracy.

The study of the spectrum has proven a most fruitful field of endeavor: to the physicist, intent on knowing the structure of the molecule and the atom, it has suggested some of his best ideas; while to the chemist is given the ability to identify the minutest quantities of elements, by examination of emission, transmission (absorption), and reflection spectra; and to the astronomer starlight has revealed, in its spectrum, the composition, and sometimes the motion, of its celestial source. Photometry, the measurement of the brightness of luminous sources and of illuminated surfaces (illuminometry), is a branch of the applied science, developed by the physicist and psychologist in close co-operation, which is of great importance to the physical investigator, as well as to the illuminating engineer.

Electricity and magnetism are nowadays treated as a single subject, although in its earlier stages of development, different types of electric and magnetic phenomena were studied as magnetism, static electricity (electrostatics), and current electricity (electrokinetics), and it was only after considerable, later work that the close relationship between them was recognized, as manifestations of the same form of energy. The division is still made for convenience in many treatises, particularly by those who favor the historical method. Magnetism covers the properties of permanent magnets, and the phenomena of magnetic fields produced by such magnets. Many of the problems of terrestrial magnetism may be considered on the assumption that the earth is a huge magnet, without regard to its source of magnetization, and most of the methods of magnetic survey have been developed under this heading. The magnetic properties of para-magnetic and dia-magnetic substances (permeability, hysteresis, etc.) may be considered here, but are more generally included as a part of electrokinetics, under the sub-topic of electro-magnetism. The «molecular» (Ewing's) theory of magnetism is here used to explain the facts, although its complete development also properly belongs to the later section.

The quantity factor of electrical energy is electric charge; the intensity factor is electric potential difference. The presence of electric potential difference across a non-conductor (dielectric) produces what is often described as a piling up on the opposite boundaries of the dielectric of equal and opposite quantities of electric charge (Maxwell's explanation of this, as a momentary displacement of electric charge across the dialectric is believed at present to be a more rational one); and this results in a state of strain, described as a field of electrostatic force, throughout the dielectric. The presence of electric potential difference across a conductor produces a continuous displacement or «flow» of electric charge across the conductor which constitutes an electric current, and which is accompanied by a state of magnetic strain or a field of magnetic force in the conductor and in the surrounding space. Study of the phenomena of the electrostatic field constitutes electrostatics, while that of the phenomena accompanying electric flow or current constitutes electrokinetics. The latter topic has proven up to this time far the more important, although the modern physics, both in theory and in practice, has been forced more and more to consider the electrostatic phenomena which accompany current flow; as for example, in electro-magnetic radiation theory and its applications in wireless communication, in the theory and the applications of gaseous conduction, and in the design and operation of long distance, high potential transmission lines.

Electrical energy becomes manifest to our senses only indirectly, as it is transformed into other forms of energy, such as heat energy, chemical energy and mechanical energy; the last most often through the intermediary of electro-magnetic force action. And the methods of measurement and of utilization of electrical energy are indirect, measuring and utilizing the transformed energy. On the other hand, electrical energy is produced by the transformation of the other forms of energy into electrical energy, and the commercial utilization of electricity became practicable only after the invention of dynamo-electric machinery, which made possible the efficient transformation of mechanical energy into electrical energy; the other methods of production being too limited and costly. Too numerous to mention are the inventions and practical applications of electricity to the needs of humanity: in communication, from the earliest telephone and the first Atlantic cable to the wireless telegraph and telephone of to-day and to-morrow; in illumination, where electricity has revolutionized the world's lighting methods; in power transmission, which has made possible the utilization of the least accessible of the world's power resources; in power application, from the largest motors to the smallest motors for fans and toys; in chemical production — the whole development of electro-chemistry; in medicine, as in the applications of X-rays; and in literally millions of other ways, in every conceivable field, electricity is serving humanity. The development of the production, transmission and utilization of electric power constitutes the business of the electrical engineer. A complete outline of this quite modern, but already very extensive subject, with its relations to electro-chemistry and electrical engineering, will be found elsewhere in these volumes. The most recent developments of electrical science in the way of advancement of knowledge of the nature of electricity itself are so epochal, so extended and so far-reaching in their bearing on all other physical theory, that their consideration is properly left to the paragraphs that follow.

Recent Developments.—Although developments of major importance have been made in all fields of the science, yet certain lines of investigation have extended so far, and have established such profound unifying principles, as to justify their recognition as new sections of physical science. The first of these is Electro-magnetic Radiation. Maxwell's mathematical theories of electricity indicated the possibility of the propagation of energy through space as electro-magnetic wave motion; a possibility that was experimentally verified by Hertz. The velocity of these «Hertzian» waves, which have since been applied with such great success to «wireless» communication, was found to be the same as the velocity of light: and from this followed directly the recognition of the identity of light radiation, of heat radiation, and of those regions of radiation of frequencies above and below those corresponding to visible light, respectively called ultra-violet and infra-red «light» or radiation, as all one and the same type of radiation, differing only in frequency and in methods of detection; while the discovery of X-radiation (and gamma-radiation of radio-active materials) has extended our knowledge of electro-magnetic radiation to what seems to be the extreme upper end of the frequency scale. The importance of this unifying principle, in connection with the others to be mentioned later, to the comprehension of light phenomena can only be suggested here; the study of light is now the study of electro-magnetic radiation; and theories advanced to explain its phenomena may be tested, not only throughout the little more than an octave of frequencies comprised by the visible spectrum, or even the much greater range available when the ultra-violet and infra-red regions are included, but throughout the innumerable octaves included between the longest «wireless» rays and the shortest gamma rays. Big unexplored intermediate gaps still exist in the «spectrum» of radiant electrical energy, due to the lack of suitable detectors or of known radiators for those regions, which leave ample opportunity for future investigation. In this field of study belong also the phenomena of fluorescence and phosphorescence, which, together with those of the «characteristic» X-radiation, form a fascinating field of complex radiation phenomena, which seem to hold many of the secrets of the structure of matter. On the theoretical side, mathematical theories to account for the phenomena of thermal radiation have been developed by Stephen, Wien, Planck and others, and the «quantum theory,» first advanced by Planck, and later modified by himself and others, has aroused widespread interest both on account of its revolutionary suggestions, and because of its wide application and remarkable agreement with many experimental facts.

Another field of investigation is that which began with the study of electric discharge through rarified gases, and which has reached its present culmination in the modern electron theory (q.v.) of electricity. On the practical side, the toy of the scientist, the «vacuum» tube, has proven the progenitor of the X-ray tube, the «vacuum» tube so essential to «wireless» apparatus, the thermionic rectifier, and many other valuable devices. The work of J. J. Thomson, C. T. R. Wilson, Millikan, and others has shown that the «electrons» or carriers of negative electricity in the «vacuum» tube discharge, are invariably associated with a fixed amount of charge; and that this charge, whose value has been determined with great accuracy, is the «elementary» electric charge, of which all other charges are exact multiples. And this conception of electric charge, together with Maxwell's theory of electric fields, provides a rational basis for the study of all of the electrical phenomena of conduction, thermo-electricity and the like, as well as of the phenomena whose existence has been revealed to us through this theory, such as thermionic currents, photo-electricity, ionization in gases, etc.

Still another field of both theoretical and experimental development is that in which attempts have been made to develop theories of the structure of matter. The dynamic theory of gases, previously quite fully developed, has been further advanced by ideas derived from progress in other fields and extended to explain many more phenomena. The discoveries in radio-activity, disclosing as they have the existence of atomic disintegration, reveal a new complexity of atomic structure, and at the same time suggest a simplicity of atomic constituents, which, together with the knowledge already gained by the observation of the behavior of electrons in «vacuum» tube discharge, has stimulated many serious attempts to build up an electric atom, consisting of some form of positively charged nucleus about whose centre electrons circle or vibrate at very high frequencies. As is to be expected, only very partial success has been obtained in devising such an atom that will be in accord with all of the known atomic phenomena, such as the phenomena of radiation and of electricity, and which will at the same time have all of the necessary chemical properties. But many isolated phenomena, such as dia-magnetism and the Zeeman effect, have already been given very satisfactory explanations in this way, while promising attempts have been made toward the explanation of many other phenomena, as for example, para-magnetism and thermal radiation («magneton» and «quantum» theories), and many chemical phenomena, such as valency and electrolysis, can now be seen clearly to be electro-atomic in their nature. No one can prophesy the future of this class of investigation. In another direction, the discovery that X-ray wave lengths are comparable with the distances between the atoms in a crystal has enabled Bragg and others to study the structure of crystals, and not only to verify the regular arrangement of the atoms, which had been guessed at previously, but as well to determine the exact positions and spacing of the atoms in a great many simple crystals: a work which is gradually extending to the analysis of more and more complex crystals. Whither will it finally lead? As the science grows the range of its knowledge and of its usefulness ever widens, yet at the same time it centres closer and closer around one great problem. Has the problem of the science of energy become that of answering the question, «What is matter?» Quite probably. But experiment shows that the mass of a moving electron is partly, and may be wholly, electro-magnetic, and thus there is more than a suggestion of the possibility that matter is energy.

Historical.— The history of science, properly written, is more interesting than the history of wars and empires: for it tells the story of the development of human ideas. Yet in spite of this, very few histories of science are to be found. Only a brief outline of the history of physics may be given here; and, aside from the few references given in the bibliography below, further knowledge of the history of physics must be gleaned from the biographies and writings of the men whose names are famous for their scientific achievements. Physics, in common with the other sciences, may trace its origins to remotest antiquity; but its modern development, which began with its recognition as an experimental science, dates from about the 16th century. Although the knowledge of the ancients of civilization — the Greeks, Romans, Egyptians and Arabians — comprised many isolated scientific discoveries and inventions, and while the writings of their philosophers often turned toward the explanation of them, yet it cannot be said that the ancients made any appreciable contributions toward the advancement of science; certainly none comparable with their contributions to other fields of thought. While it can be said that the authority of their master philosophers, such as Aristotle, stood a formidable barrier to scientific advancement for centuries, the confused and intimate relations between scientific, metaphysical and mystical ideas, combined with an inexplicable disregard of experiment as a means of interpretation of nature, opposed any real advancement. The achievements of Archimedes in the fields of statics and hydrostatics stand among the few solitary exceptions that foreshadow the modern scientific viewpoint.

During the Middle Ages much of the scientific knowledge of the ancients was irretrievably lost, and most of that which survived lay dormant. The supreme authority of Aristotle among the scholastics, and their syllogistic methods of reasoning, prevented any advancement of physical science by them. Only the alchemists, whose secret work must have discovered (and lost) many a scientific truth; and a few inspired men among the scholastics, such as Roger Bacon, kept alive the spark of progress that burst into flame in the later Italian Renaissance with the work of Galileo Galilei. Galileo's experimental studies of the motion of falling bodies are the first of their kind, and may truly be said to date the beginning of modern science; although the studies in magnetism of his contemporary, William Gilbert, are scarcely less epochal. From then on the opposition and persecution, which had so hindered progress on the part of Galileo and his predecessors, weakened and finally broke down, and the development of the new science progressed rapidly. The history of the science can for a while now be outlined by mentioning great names. Torricelli, Pascal, von Guericke, and later Boyle, Mariotte and others discovered in quick succession the properties of the atmosphere and of gases and extended and unified the knowledge of hydrostatics. Huygens laid the foundations of physical optics, although building on them was deferred until nearly a century later. The list culminates in the name of Newton, who, born in the year that Galileo died, built upon the work of Galileo, and gave us our complete system of mechanics in his 'Principia,' published in 1686-87. His experimental investigations in light added greatly to the knowledge of that subject, although here he was unfortunate in his theoretical reasoning.

During a period which includes the 18th century and the early part of the 19th century, the spread of popular interest in experimental science, already noted in the foundation of the Royal Society of London in 1662, of the Académie des Sciences at Paris in 1666, and of the corresponding society at Berlin in 1700, stimulated scientific effort to an extent which made this period pre-eminently one of scientific discovery. The names of Franklin, Cavendish, Black, Young, Fresnel, Galvani, Volta, Ohm, Ampère, Gauss, Davy and Faraday represent only a part of those whose brilliant discoveries and clear thinking brought about such rapid advances in all branches of physics. Some of these, such as Franklin, Cavendish, Black and Davy, are to be recognized as men also prominent in other and now far separated activities. This versatility is better understood when it is remembered that it was only after the discoveries of this period had added so much to the knowledge of natural philosophy, as all of physical science was then called, that its differentiation into specialized sciences — physics, chemistry, etc.— began; and that, even after chemistry obtained individual recognition, physics formed the major portion of what remained, and was known as natural philosophy for considerable time thereafter. The Industrial Revolution in England about 1770, brought about as it was by scientific discoveries such as those which resulted in the invention of Watt's steam engine, had a profound reaction on scientific discovery in the 19th century.

The discovery of electro-magnetic induction by Faraday in 1831 made possible the invention of the dynamo, whose commercial importance was at once recognized, and developments of commercial applications of electrical energy took place with great rapidity. In another direction a new tendency is to be noted in the establishment, during the first half of the 19th century, under the leadership of Helmholtz, Mayer, Rumford and Joule of the principle of conservation of energy and of its universal application. William Thomson (Lord Kelvin) was an important participator in this work, which he carried further by applying the principle to the co-ordination and extension of the theory of thermodynamics which had been so ably begun by Carnot and his contemporaries.

These two points of departure along new and divergent lines of development, between which experimental investigation continued to flourish, mark the beginning of the modern period of science. The history of the commercial side is initiated by a remarkable series of brilliant inventions such as the telegraph, telephone, trans-Atlantic cable, incandescent lamp, electric traction, etc.; and its later details belong to electrical engineering. On the purely scientific side, development has been no less rapid, though until recently, less spectacular. Maxwell's genius early shaped the course of all later theoretical reasoning in electricity and light, while Kelvin developed much of the apparatus now used in electrical measurements. Joule, Amagat, Andrews and others continued the experimental studies begun by Charles and Regnault of the properties of gases, where later a spectacular result was realized in the liquefaction of air and other gases.

The history of the later developments of this period has been touched upon in a previous section. Few discoveries stand out in their entirety as do the discoveries of X-rays by Roentgen in 1896, of radio-activity by Becquerel the same year, or of radium by the Curies in 1898. The developments have been so varied, and much of the advancement has been by a process of growth through the combined efforts of so many men, that it must be left to the historian of 100 years hence to look back over this period and properly to adjudge its achievements.

Bibliography.— No attempt is here made to even begin to give a complete bibliography of the science. This would be impossible. The following lists contain references to only a representative few of the more recent and more important publications in English, except that a fairly complete list of periodicals is given. Only general treatises are mentioned. For further study recourse should be had to the treatises covering the special topics of physics, and for these the reader is referred to the bibliographies under the corresponding articles included elsewhere in these volumes.

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PHYSIOCRATIC SCHOOL, in political economy, a school in France headed by Quesnay (q.v.) and Gournay (q.v.), who, in opposition to the Mercantile System, regarded the production of raw materials, and more especially agriculture as the great source of national well-being, and sought to regulate legislation accordingly, laying special stress on the requirement that the revenues of the state ought to be raised by a single tax on land. See Political Economy.

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PHYSIOCRATS. See Economics.

PHYSIOGNOMY (Greek, *physiognomonia,* literally, the judgment by bodily appearance), the art of judging character from the countenance. We are generally impressed at first sight favorably or unfavorably, in regard to the temper and talents of others, by the expression of their countenances. As the face is that part of the body in which the noblest external organs are united, by which men put themselves in contact with the world, and, for various reasons, show most of their characteristic traits, it has been made the particular object of study by the physiognomist. Aristotle was the first known physiognomist. He observed that each animal has a special instinct; the fox cunning, the wolf ferocity, etc., and he concluded that men, whose features resemble those of certain animals, will have the qualities of those animals. Battista della Porta, in his work 'De Humana Physiognomia' (1586), revived this theory and carried it out further. The French painter Lebrun, in the 17th century, executed a series of pictures founded on the resemblance between the human figure and that of animals; and his theory was also adopted and illustrated by Tischbein, a German painter of the 18th century. The physiologist Camper sought new data in a comparison of the heads of different types and decided the degree of intelligence belonging to each from the facial angle. Lavater was the first to develop a complete system of physiognomy, which included all the relations between the physical and moral nature of man. (See Lavater). As the expression of the face depends very much upon the formation of the skull, physiognomy is connected with craniology. Among the chief points in physiognomy, Kant, in his anthropology, reckons — (1) the general formation of the face, particularly in the profile; (2) the individual features of the face; (3) the motions of the face, as far as they have become habitual; also the walk, etc. Kent and others think that physiognomy can never be elevated to a science. It is, however, a subject of great interest; but the student must be on his guard against a general application of its formulated rules. Even Lavater's system lasted but a short time, though he has collected valuable materials. In the 19th and 20th centuries the subject has been taken up in a more scientific way by physiologists and psychologists and a very extensive literature has come into existence. A great deal of the latter, however, especially in recent years, is of the popular-scientific type and ought to be used with considerable care in regard to the correctness of its conclusions.

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PHYSIOGRAPHY (Greek, *physis* = *nature* + *graphia* = description), has been variously defined. By many it is considered to be synonymous with geomorphology or geomorphogeny. In this sense it may be defined as the science which treats of land forms and their origin. On the other hand it is considered by many as equivalent to physical geography, and a recent authority has defined it as "that science which investigates the physical features of the earth and their influence on life, especially man.» The geologists in general tend to favor the former idea; the geographers the latter. In the modern development of the subject there is a strong tendency to emphasize the more purely geographic aspects of the science; or, as some one has said, to humanize it.

Physiography has been called the latest chapter in geology, a very apt phrase when applied to geomorphology proper. It covers largely the same subject matter treated in dynamical geology, namely, the processes and forces now operating to modify the earth. Physiography, however, investigates these facts, as a key to the study of human progress; dynamical geology because it is only in the light of the processes now in operation that we can interpret the history of the past, as locked up in the rocks.

Change of seasons, tides, wind circulation and their geographic relations are so directly dependent on astronomic considerations that a preliminary study of the earth in its relations to the universe is essential to physiography. Because of the activity of atmospheric agents in shaping land forms, physiography is often prefaced with a brief study of meteorology and climatology, with special reference to wind, temperature and rain, their cause and distribution. A brief study of rocks and minerals is also necessary, since it is possible to understand the activities shaping the earth's crust only when we know something of the nature of the materials upon which these forces act. The subject is not infrequently divided under the headings of the atmosphere, the hydrosphere and the lithosphere.

The Atmosphere.— For a discussion of the composition and direct geologic activity of the atmosphere as a weathering agent see the section on *Work of the Atmosphere* in the article on GEOLOGY. In addition to these factors more important considerations to the geographer are winds, temperature and rainfall. The great wind belts are shown to be the result of excessive heating in the equatorial regions, causing the air drifts from the poles toward the equator, and this is modified by the earth's rotation giving belts of winds and calms. Unequal heating of land and water and the trend of mountain ranges modify the planetary wind belts and give local variations. Temperature depends primarily on latitude, but temperature belts are modified by proximity to oceans or large lakes, and by the effect of mountain ranges on wind direction. Precipitation is largely dependent on wind movements. In the equatorial belts of calms where the air is rising and cooling, rain is abundant. Deserts are the rule in the horse latitudes, where the air is descending and becoming warmer. Winds blowing over high mountains are forced to give up their moisture on the windward side, and are dry winds beyond the mountain ranges. The physiographer is concerned with all these facts in their effect on man and his activities, both directly as the sum total of climate, and indirectly in shaping land forms. See AIR; WIND; CLIMATE; GEOGRAPHY and GEOLOGY.

The Hydrosphere.— The geologic aspects of the waters of the earth's crust have been discussed in the sections on *Work of Oceans* and *Work of Lakes*, in the article on GEOLOGY. See also OCEANS and LAKES.

The ocean as an equalizer of climate is of interest to the physiographer, since it is a well-known fact that regions near the ocean do not have the extremes of temperature that exist in the interior of continents. Ocean currents are important in this respect. The warm Gulf stream and the cold Labrador current accounting respectively for the equable climate of England and the bleakness of Labrador. The ocean as a highway for human traffic and as a source of human food are within the scope of physical geography. The smoothness or irregularity of shore lines, which results from geologic processes, determine the nature of harborage. Still within the scope of the physiographer's research but less directly, so are the processes of sedimentation going on in the ocean, since these control in part the types of rocks with which man has to deal on the earth's surface.

The Lithosphere or Solid Earth.—As the home of man and the source of most of the products he utilizes, the lands hold the largest place in the research of the physiographer. Here he is faced with two problems; a study of the origin of land forms, and the determination of the influence of land forms on man and his pursuits. The first of these problems has already received attention in the section on *Dynamical Geology,* under title of GEOLOGY. The second will be briefly considered below. The major relief features of the lands are plains, plateaus and mountains, and each has its own characteristic effect on life of all kinds.

Plains.— Plains are of several varieties. Coastal plains lie between the shore line and the higher, often mountainous, interior. A typical example is the Atlantic coastal plain. Not all coasts have such plains, but when they do, the region is usually one recently emerged from the sea. It is likely, therefore, to have long straight coasts and few harbors. A slight recent sinking of parts of the Atlantic Coast of the United States has fortunately resulted in good harbors. Because coastal plains are recently emerged sea bottom, and because when submerged they were being overspread with sand deposits their soil is frequently sandy. The Atlantic Coastal Plain has large stretches of infertile soil, but because it faces America's greatest market — Europe, and has good harbors, it has undergone rapid development. Flood plains and delta plains on the larger rivers are often very extensive. The rivers are sluggish, carrying little coarse sand or gravel, and from year to year in time of flood they have spread out broad layers of fine rich soil until they comprise some of the richest agricultural lands of the world. They are usually densely populated with an intelligent and progressive class of people. Their most serious drawback is from flooding, which takes toll of many lives, and millions of dollars' worth of property each year, on the great flood plains of the world, like those of the Mississippi, Nile, Ganges, Danube and the Hoang Ho. Many other types of plains are known, and each has its characteristic relation to human activity.

Plateaus. Plateaus are elevated plains, usually bordering or enclosed by mountain ranges. For this reason they are often cut off from rain-bearing winds and are semi-arid, as our western «Great Plains,» (more properly spoken of as plateaus) and the Columbia Plateau; or truly desert, as most of the «Great Basin,» which is, properly speaking, a plateau carrying mountain ranges on its extensive surface. Some of the very elevated plateaus, such as the Colorado Plateau, rise so high that, even in the midst of deserts, they receive enough rain to support splendid forests. Because of their great elevation and sometimes due to their aridity and isolation by mountain chains, plateaus are less favorable to population than plains. Where these high plains are deeply dissected, as in the Allegheny and Cumberland plateau region, they are often called mountains, and resemble these latter in their effect on civilization.

Mountains. These are the most striking of nature's forms and contain the grandest scenery in the world. They are also of profound influence on all life history. For the most part rocky, isolated and inhospitable, they form rather barriers than homes. It is true that mountains have many times in the history of the world offered asylums to weaker peoples, driven out of other lands by religious or political persecution, but their most important rôle is to act as barriers. They deflect winds or rob them of their rain, so that in the lee of mountains often lie deserts. They prevent the migration of many types of plants and even some members of the animal kingdom. Even to man they present serious obstacles to travel and transportation, more so formerly than now. In the isolated valleys of the more remote mountain regions are crowded the stragglers of the world's migrations, and there, old customs, traditions and manners of speech are preserved among ignorant and illiterate peoples long after they are forgotten elsewhere. Because mountains are often the seat of extensive volcanic activity, and because volcanic processes are largely responsible for deposits of valuable metals, mountains are often important mining regions. It is the search for metallic wealth more than anything else that has peopled mountain regions with progressive populations, and except along tourist routes, few important cities exist in mountainous areas other than in mining districts.

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PHYSIOLOGUS, an early Greek bestiary. See BESTIARIES. Consult Goldstaub, M., ‘Der Physiologus und seine Weiterbildung’ (in ‘Philologus,’ Supplementband VIII, p. 337, Leipzig 1899–1901); Hommel, F., ‘Die Aethiopische Uebersetzung des Physiologus’ (Leipzig 1877); Lauchert, F., ‘Geschichte des Physiologus’ (containing the Greek text, Strassburg 1889); Peters, E., ‘Der Griechische Physiologus und seine Orientalischen Uebersetzungen’ (in 15. Festschrift, Gesellschaft für Deutsche Philologie,’ Berlin 1898); Thierfelder, J. G., ‘Eine Handschrift des Physiologus Theobaldi’ (in ‘Serapeum,’ Vol. XXIII, pp. 225 and 241, Leipzig 1862).

PHYSIOLOGY. Physiology is the science that deals with organic processes or function. In such a very general definition, the word «function» applies not to machines (because we do not know that organisms properly are machines), but to organism. It does not refer to organic motions merely, but to functions, and many motions are not functions or even processes. As part of the definition of this science, it may be worth noting that it is in logical contrast on the one hand with anatomy, and in probable continuity with psychology.

Varieties of Physiology.— Plant-physiology will be discussed elsewhere in this work, but it is obviously as much physiology as is any other kind. Animal physiology deals with those organisms which, for example, consume oxygen both day and night, whose catabolism outruns their anabolism; but there is no sharp line of demarkation.

Animal physiology properly includes human physiology. Such differences as there are between brutes and humans are due mainly to man's unhygienic life, to the greater influence of his mind, and the larger development of his moral nature. Leave out the considerable influence of these, mostly social, forces, and human physiology is much more like animal physiology than many of us would care to admit,— however much we need to admit it.

Academic physiology is nothing more nor less than unapplied physiology,— pure science for its own sake. As such, it has very great disciplinary value, equaling or perhaps exceeding in this respect anything that mathematics has to offer, for to many mathematics is actually repellant, while physiology is sure to interest even though it repels.

Medical physiology in its old form of 20 years ago is rapidly passing. On the other hand, in its new form, it is as yet undeveloped, so that to-day medical physiology is betwixt and between. It is neither a pure academic science nor a properly applied science, but in many medical schools a traditional hodge-podge of outworn and more or less useless material, especially in its laboratory aspects. Medical physiology is allied on the one hand to prophylaxis (hygiene), and on the other hand to therapeutics. Since, as a matter of fact, physiology as taught is very largely found in the medical schools and the dental schools, we may there perhaps get the best notion as to its material, if not as to its method.

The matter of physiology, then, relates to at least three distinct modes of viewing organic function:

First, there is that ancient term «vital,» referring of course to processes. An encyclopedia article is no place to enter into polemic discussions. On the other hand, to discuss physiology without a reference to this matter would be to leave such a discussion quite inadequate. More and more scientists and philosophers to-day are thinking of «Life» as a category, and one scarcely less general to the human mind than space, time and causality. Men are gradually realizing as they look farther afield into the reality of things, that life and consciousness and energy and matter are but aspects of the Real. This conclusion cannot be avoided, I think, by any serious student of Life, especially of human life as it actually is about us and within us. It is easier to be skeptical and even scorn the term «vital» (especially as a reaction against a former unwarranted notion of it), than to replace that which it stands for with something more precisely scientific. Recent thought tends above all things to emphasize continuity, and the continuity just suggested above obviously tends to give to the term «vitalism» a meaning which no one can properly deny, that is as an inseparable part of the consciousness-subconsciousness-energy-matter «continuum» with which physiology must be concerned.

But from a narrower point of view, the term «vital» stands, it must be admitted, for processes not yet comprehended and understood. It is a real name, none the less, and stands for a reality. The splendid work of Jacques Loeb, now of the Rockefeller Institute, perhaps on the whole the most searching into these matters that has been carried out, has always left a distinct impression on the unbiased reader that the results stop just where they should begin if vitalism really is to mean anything more than physics and chemistry. The old familiar example germplasm, and its indescribably intricate content, the transfer of the energy of proteins and of fats and of carbohydrates into the chromatin of nerve-cells, and therethrough into the nerve impulse called neurility, and therethrough again into mental processes, suggests a meaning to vitalism which the skeptic can deny only by refusing to think it out or by adopting some hypothesis of which there is no present proof, such as psycho-physical parallelism. In short, the broad-minded thinker on organic functions at the present time seems to have to admit relationships in organic life for which the word «vitalism» may well be allowed to stand — until at least its uselessness has been demonstrated.

A second aspect of the matter of material of physiology is classed as *physical*. This aspect of the science discusses function as motion, in short. Motions are of two kinds in living matter as in other kinds of matter, namely molecular and molar. The term molecule means little to-day with the decadence of the term atom, but nonetheless the word is in universal use, and stands in physiology for those attractions and repulsions which, viewed from a somewhat different angle, we term chemical. Metabolism is molecular movement, so are heat and light, electricity, nerve-force, and all those processes which to-day are on the border line between physics and chemistry. The energies of the body, in short, are reducible to modes of molecular movement. Unless we insist on vital processes as something distinct, the molecular movements of living matter, so far as we can see, are no different from those of nonliving matter, *except* in one fundamental particular, namely their complexity, and this difference does not always obtain.

Molar movements may of course, for the sake of logical completeness, be classed as properly organic and as merely passive. The organic movements proper are again divided into two kinds, the first being muscular or active movements, and the second recoil or passive movements. It is worth noting that muscle is the sole organ for active movement in organism, although its precursors include such processes as cell-turgor, protoplasmic streaming, and even various grades of direct contractility and possibly of expansion, produced by various forms of contractile threads. Muscular movements are classed as vegetative and as voluntary or personal, although these, like everything else, merge more or less insensibly into each other in the living organism.

The recoils are passive and include such essential movements as the probable passive mechanical constriction of the arterioles, of the lungs, of the urinary bladder, in short of any distended viscus. The torsional recoil of the costal cartilages is obvious in one's mind, as well as others of still less importance. Some of these recoils are made more of than fact sanctions, in all probability; even the most important of them all, the constricting process of the arterioles, may prove to be, after all, an active movement, and not a mere passive mechanical recoil. Molar movements have as their qualities: first, quantity, referring to the mass of active muscle concerned in them; second, extent, referring obviously to the amount of linear space involved in a shortening of the muscle; third, speed, which means the amount of space covered in a unit of time; fourth, location, which has importance in the applied science of kinesiology and in general physical education; fifth, force, which in this case means the capability of overcoming resistance and not necessarily through space (here, pure physics has for once shown the inadequacy of some of its old definitions); sixth and lastly, duration.

It would be pedantic for any physicist to claim that the processes of an organism which he might care to class as «physical» did not merge over a considerable area with those that are more often called «chemical.» Protoplasm includes so much, that at present to say what of its processes are physical and what chemical would be pure arbitrariness, just as both the botanists and the zoologists still include certain infusoria in their tectonic schemes.

The *chemical* processes of living matter, in many cases, are indescribably, and so far as we can see, unimaginably, complex. So far as we can realize at present, this may be their chief difference from inorganic chemism. In addition to these intricate chemical reactions of attraction and repulsion between the atoms, of course all the simpler ones are going on universally. Every organism is a marvelously complicated chemical laboratory where untold multitudes of complex substances are made and unmade and intermixed; every organ is such a laboratory; some have even ventured to suggest that every cell carries on essentially this same complexity of chemic work. As an index of this intricacy of chemism, one need only to be reminded that the molecular weight of some of the component compounds of protoplasm is probably at least 150,000. As some biologist long ago suggested, it may well be that in this complexity and perhaps characteristically so, lies the secret of Life; in other words, that the living molecule lives because it is more complex and more intricately unstable than is any other substance.

A few years ago, in many of the medical schools of mark at least, there was plain a tendency to give up to bio-chemistry the more narrowly chemical functions of organism and to think of physiology more and more as a science of physical reactions. Then about this time we began to have an inkling of the unparelleled importance and influence of the products of the ductless glands, and, as one might expect would have happened, this stimulated anew the former absorption in chemical physiology. At the present time, therefore, a considerable proportion of the research-work being done in the laboratories of physiology is chemical in its relations and aims. One might almost say that various aspects of metabolism was at present the chief research-problem of physiology, however unfortunate for the rounded dignity of physiology such a condition of things may be. Certainly the only reason that bio-chemistry does not claim its own and insist that physiology attend to its more properly own affairs, comprehending the functions of protoplasm as a whole, is that modern chemistry plainly already has very much more than it can attend to by itself. There is room for the relatively unexpert chemic research of the physiologist, as the medical school knows him.

The relations of physiology need not detain us long. Those most obvious and close are with biology as the general science of life; to anatomy as a comparatively narrow phase of morphology; to chemistry; to hygiene, part of which of course is physiology applied to the maintenance of health as long as possible; to therapeutics; to neurology; to psychology in all its protean forms; to philosophy, and even at times and in certain minds to metaphysics. The self-respecting physiologist is invariably a fairly good student of biology, and if he knows nothing and cares less about metaphysics, at least it is undeniably true that the metaphysician no longer snorts at the suggestion that a little physiology would not hurt his wisdom,— although he seldom or never acts on the notion.

Applications of physiology. Without talking much about it or making it very explicit in the public mind, physiology has far outdistanced psychology in applying itself usefully to life, and yet scarcely a beginning has been made, especially since the applications of physiology scarcely realize that they are applications. In one sense, and to a degree, the applications of physiology were made before the physiology itself.

In the days of Oliver Wendell Holmes, for example, one man, with some assistants probably, taught all the anatomy and physiology that was given in the Harvard Medical School. As things were just before the great World War began, at least 20 men, each of whom probably knows more of medicine than Oliver Wendell Holmes (great as are his contributions to medical science and to literature), instructed in anatomy and physiology in the same school, and the annual budget of these two departments was certainly several times the entire income for the sale of course-tickets in Dr. Holmes' day. Much of this money to be sure is expended in expensive practical work rather than in salaries for mere lectures.

Among the most obvious applications of physiology are those seen in physical education, especially in the physiology of exercise; in medicine; in general education; and the most recent of them is to the orthopedic re-education of the maimed and crippled, and those suffering from war neuroses sometimes still called “shell-shock.”

Methods.— Physiology is slightly deductive from the principles of biology and from structure. Although it is certain that no one could discover the action of some machines from the unmoving machine itself, it is equally true that other mechanisms bear in their very structure, so to say, a moving picture of their action. In no mechanism or near-mechanism perhaps is this less true than it is of organisms, the reason for this being apparently the minute complexity of many of its mechanisms. The heart, for example, certainly bears in its anatomy its mode of action, for it is in part a matter of direction of blood-stream through unalterable valves workable only in one direction; on the other hand, decades of study were required to explain under what precise conditions the heart contracted, in relation to the nervous-system.

The failure of deduction as a physiological method has its most striking example in the brain, and it is in a degree literally true that the men who really knew most about the human brain are those least certain of its processes — a statement of which elementary students of physiology delight to remind their instructor just before examination!

Physiology is largely inductive from experimentation. For one good guess made by the physiologist with imagination, at least a hundred more or less important facts have been discovered by experiment, often elaborate beyond the comprehension of the untechnical. No science is more inductive than physiology. Laboratory-physiology is a highly complex art in itself, an art continually changing, and we may say, simplifying, reducing itself to its lowest terms. Many of the greatest discoveries of modern times have been made by mechanisms of the simplest type, which differ from those employed in previous researches by being underlaid by an ingenious new idea.

A glance at any of the laboratory-manuals of physiology, such as that for example of Cannon, published by the Harvard University Press, shows how instructive and at the same time how elaborate and expensive of time and money such a course to-day must be. The present writer, if he may be allowed to intrude a bit of his work, has already developed a laboratory course in physiology, suitable for elementary and secondary girls' schools of all grades, and dealing wholly with animalculæ. This article summarizes itself as follows:

A LABORATORY COURSE IN PHYSIOLOGY BASED ON DAPHNIA, ETC.

I. *Introduction: Vegetal and Animal Histology.*
II. *Comparison of Living Vegetal and Animal Cells:* Bacteria, desmids, diatoms, Edeogonium, Spirogyra, Euglena, ciliated infusoria. The relations of micro-organisms to disease.
III. *Protoplasm and its Streaming: Ameba.* Surface-tension. Universal versatility.
IV. *Locomotion by Cilia: Paramecium, Stentor.*
V. *Simple Forms of Muscle: Hydra, Stentor, Vorticella, Brachionus.*
    A. The reaction-time of Stentor's or of Vorticella's myonemes.
    B. The relaxation-time of Stentor's or of Vorticella's myonemes.
    C. The spontaneous contraction-rhythm of Vorticella.
    D. Fatigue in Vorticella's myonemes.
    E. Exhaustion in Vorticello's myonemes.
    F. Individual differences in the movements of Stentor and of Vorticella.
    G. Skeletal muscle.
VI. *The Molar Movements of Simple Metazoa: Hydra, the rotifers Philodina, Brachionus.*
VII. *Dessication and Re-humidification: Tardigrada, Philodina.*
VIII. *The Anatomy, Gross and Microscopic, of Daphnia.*
IX. *Nutrition: Daphnia.*
    A. The water-currents toward the mouth.
    B. Deglutition.
    C. The digestive glands and their movements.
    D. Peristalsis.
    E. Speed of the antiperistaltic wave.

IX. *Nutrition: Daphnia* — continued
    F. Frequency of the antiperistaltic waves.
    G. Defecation.
    H. Catharsis.
    I. Correlation in the alimentary canal.
X. *Blood: Daphnia.* (Compare Hydra and Man.)
    A. Number and size of the amebocyte-corpuscles.
    B. Shapes and intrinsic movements of the corpuscles.
    C. Change of color on exposure to air.
XI. *Circulation: Daphnia.*
    A. The heart. Systole and diastole.
    B. The average heart-rate.
    C. The effects of varying temperature on the rate.
    D. The heart's extreme persistence.
    E. The blood-sinuses. Osmosis.
    F. The effects of electricity on the heart.
    G. The effects of blood-salines on the heart; osmosis.
    H. The effects of certain other drugs on the heart.
    I. Correlation with extrinsic conditions.
    J. The embryonic heart-rate: why slower than the maternal heart-rate? Myogenesis *vs.* Neurogenesis.
    K. The cardio-inhibitory centre.
XII. *Respiration: Daphnia.*
    A. Direct respiration.
    B. Structure of the gill-feet.
    C. Rhythmic movements of the gill-feet.
    D. Apnea?
    E. Effects of carbon dioxide in excess.
    F. Effects of a lack of oxygen.
    G. Effects of carbon monoxide.
    H. Hemocyanin in solution.
XIII. *Muscle and Muscle-Action: Daphnia.*
    A. Smooth muscle of the alimentary canal.
    B. The eye-muscles. Convulsive action.
    C. Voluntary muscle of antennæ, etc. Fatigue.
    D. Cardiac muscle. Tonus. Actions of the ions in the various blood-salines. Absence of obvious fatigue.
XIV. *The Nervous System: Daphnia.*
    A. Brain and optic lobe.
    B. Moto-sensory circuit: Retzius's work.
    C. Augmentory action: heart.
    D. Inhibitory action: heart.
XV. *Taxes: Daphnia, Cyclops, etc.*
    A. Chemotaxis: Paramecium, Anurea.
    B. Phototaxis: Daphnia, Ameba.
    C. Thermotaxis: Paramecium, Oxytricha.
    D. Electrotaxis: Cyclops.
XVI. *The Senses: Daphnia.*
    A. Vision: Range and acuity.
    B. Touch. "Reflex" removal of irritants.
    C. Taste.
    D. Smell.
XVII. *Embryology: Daphnia.*
    A. Summer eggs and their development.
    B. Winter eggs.
    C. Parthenogenesis.
    D. The brood-sac and its secretion.
    E. Coalescence of embryonic eyes.
    F. Comparison of various functional rates in embryos and in mother.
XVIII. *Animal Behavior: Paramecium, Hydra, etc., etc.*
XIX. *The Mental Life of the Animalcules.* The inherent individual will.

One finds here basal and important principles of universal physiology, and the ingenuity of other experienced physiologists would surely indicate and define many principles more. The essentials of much physiology certainly are present in experimentation of this relatively simple kind.

The standing of this pioneer endeavor as a pedagogic proposition, as a scientific method, we may attempt to justify at the present writing under six heads. The first of these heads we may suggest as *the substantiality and the variety of the physiologic principles that can thus be studied.*

A second possible feature of this manner of teaching elementary physiology has been alluded to by implication already: *the transparency and the smallness of the animals used make more striking and easy of acceptance the essential unification of parts into the animal whole.* In Daphnia this is notable in the interest a first viewing of the animalcule invariably excites whether in man or child. One actually sees, for example, the blood corpuscles that are kept in circulation by the heart pulsating under the observer's eye; and the intestinal peristalsis can be actually seen to advance up the gut in relation with the pulsations of the digestive gland. Here is unification too obvious to be missed even by the careless child. Without a comprehension of the interdependence of his bodily parts he can learn neither to understand himself nor how to keep well!

A third advantage of such a course lies *in the simplicity and the inexpensiveness of the apparatus required.* Many elementary schools have compound microscopes, and every school or even every student could provide at least a strong pocket-lens, which might be made to suffice. Beyond the microscope the apparatus required is almost nothing not afforded by every laboratory of chemistry, if we except a few always-present implements such as a watch, a millimeter rule and small and simple glassware. To those of us who know the considerable expense of most of the apparatus that we use this factor will appeal. At any rate, it puts this course within range of any school, no matter how simple or indigent or isolated, and makes more affluent schools more independent than heretofore of the avaricious apparatus-dealer.

In similar manner, *the life-material required is always obtainable with great ease* and with little or no expense, summer or winter, and throughout the world. As is well known, these animals have an almost earth-wide distribution and are easily gathered from pools and streams. If this be not convenient, a few cents for postage brings most of these animalcules within easy reach of such few schools as for special reasons might not care to maintain the simple jar-aquaria for breeding them. They come in such countless numbers so readily that whoever made a business of supplying them could not conscientiously, one would hope, charge for them more than the smallest public class could easily pay.

Ease of maintenance of the animalcules is an advantage close to that just mentioned. Instead of ill-smelling animal-rooms expensive to maintain, containing unhappy large animals often both hard and expensive to properly feed, the animalcules are kept in more or less attractive glass aquaria that need contain no more than a few litres of water each for use of large classes. Many of these little animals maintain themselves year after year. Daphnia, for example, not "running out" as long as one uses just ordinary intelligence in imitating a simple environment somewhere near that which is natural to it. The infusoria, of course, Stentor, Paramecium, etc., can be readily developed at any time in two weeks from old leaves and hay and similar commonplace material, everywhere and always at hand.

No one with a quirkless brain can nowadays fail to justify vivisection by competent scientists, but many, nonetheless, men as well as women and children, savants as well as fools, dislike to do this work, especially for purposes of routine class-instruction. This repugnance to blood-shedding and mutilation is obviously a necessary human feeling worthy to be cultivated rather than blunted. (In the vivisection polemics one sees too seldom perhaps due credit given us animal-experimentalists for the performance of disagreeable death and mutilation on animals whom we of all men best appreciate at their marvelous value and perfection). Strangely enough, the size of the animal is a factor in the determination of the strength of this feeling of repugnance to mutilation found in all normal human beings, while another of its determinants is complexity. Men of culture who would hesitate to kill a mouse or to drown a puppy have no such feelings ordinarily in regard to ants, however wonderfully efficient in their complex living, or in regard to the medusoids, however large and conspicuous. Thus *the animalcules may be adequately studied by young or old, by boys and girls, without a prohibitive feeling of repugnance* to the destruction of life. This circumstance is both justifiable biologically and ethically and practically convenient for teaching purposes, and gives the animalcules an advantage for scientific purposes not easy to exaggerate.

It has been already sufficiently implied perhaps that this course in practical physiology is for elementary use, although it serves a helpful purpose also as an introduction and advance summary epitome for courses of physiology the most advanced and technical, as routine experience indeed has shown. In high schools, in academies and in academic (collegiate) curricula, particularly in those for women, one might expect its value especially to be demonstrated. From such schools all laboratory-physiology worthy of the name has been heretofore excluded. It is on this basis and with this intent that the present tentative suggestions have been offered to the science of physiology, for development into an efficient new educational method. (Reprinted from the *Boston Medical and Surgical Journal* (vol. CLXVII, No. 5, pp. 153–156, 1 Aug. 1912); and from the *Biologische Centralblatt*, Bd. XXXII, No. 5).

In the light of the colossal slaughter of men and children, women and maidens in the present European conflict, the vivisection problem, interesting as it is to every kind heart, fades into relative insignificance! Physiologists have taught physiology to considerable classes for a great many years without doing any vivisecting, but it is undeniable that vivisection (without pain or acute discomfort, invariably) without exception is indispensable to the advancement of physiology and of medicine. The reason for this indispensableness of the vivisection of invertebrates and even mammals lies not only in the essential similarity of the brute and the human organism, but in the often grievously ignored fact that an organ or tissue isolated from the family of which it is a part, is scarcely more that organ or that tissue as it properly is than a slice of «liver» on your breakfast-plate is liver in the living animal from which it came.

The most conspicuous example of the lack of consideration of this then undiscovered fact is the grossly misleading study of muscle isolated from the body of its animal, and already hastening to decay, at first without moisture, without warmth, and even now always without its own intrinsic circulation. To-day physiologists for the most part realize that an isolated organ or tissue has only the faintest hints to offer as to its normal mode of action. Think of one trying to study the life of a muscle entirely deprived of its usual changes in adrenin, dextrose and alkalinity, not to mention other essential factors of the living blood! These numerous researches on isolated tissue have undoubtedly served important use, but it is likely that they are not being rapidly enough abandoned even yet for the more philosophic methods of recent days, which study, the best that may be, the normal entire animal.

Vivisection is indispensable for this kind of work, but vivisection always without pain or acute discomfort, as indeed has been very generally the custom everywhere for a generation at least.

Divisions of Animal Physiology.— These, of course, are wholly arbitrary for any one discussing the subject, but, as one may see from the writer's textbook, the following topics may well enough serve as chapter headings:

Protoplasm should be described morphologically, physically and chemically in every textbook of physiology intended for the use of students. A baker might succeed in making good bread and pastry out of various grains without knowing anything about these grains and their mode of preparation for his work, but the probability, none the less, is that the baker who has milled his own meals and flours and studied their physical properties and respective chemical compositions will make a more artistic product than another. All recent textbooks, so far as the writer is aware, have remedied this old-time defect in physiological textbooks which left protoplasm to some supposed but usually imaginery biologist.

The *Nervous System* is the next logical beginner of a systematic treatise on physiology, as it is one on psychology. Although in some respects the hardest part of physiology, the remainder of the subject cannot be understood unless the chief actions of the autonomic system, spinal cord and the brain are comprehended. Physiology, then, should take the bull by the horns, and, with the aid of anatomy and histology, teach the physiology of the nervous system the first thing after protoplasm has been achieved.

In like manner *Muscle* should be understood and appreciated before the other functions of the body are undertaken. The body in its essence is motion, a mechanism for dislocating material objects or matter in space. Motion, therefore, is its essence, and it should be well understood accordingly.

As the third part of the mechanism of efficiency the *Glands* should be studied. Endocrinology, the modern science of the functions of the ductless glands, is the most active and at present the most productive part of physiology, and the more we learn about it, the more important does it appear to be. It pervades modern physiology.

Dietetics and *Nutrition* are the natural topics to come next, the latter term to include excretion.

The *Circulation* logically is the next thing in order, because it is the blood and the lymph which distribute all the required materials, and collect all the undesirable materials of the organism for prompt removal.

Respiration, although in a sense next to motion the most fundamental of organic functions, may be considered in one place as well as another, although not, certainly, until part at least of the chemical and the neuro-physical movements of the organism have been learned.

Respiration is at heart a chemical process, a fact which some students are slow to learn, but which is fundamental.

There is no reason known to the writer why *Reproduction* should always be found at the latter end of a general treatise on physiology, since no apology need be offered for discussion of this base-function. It "goes" at the end, however, as well as anywhere else. In the majority of textbooks, even to-day, it certainly is discussed inadequately, a bare outline being given, and the entire hygienic aspect — the only aspect in which the majority of young men and women really need information — is wholly ignored. In many schools it is not customary to systematically teach this subject at all, apparently not altogether out of "modesty," but because every medical faculty realizes that this ordinarily is the first chapter of the textbook to become really familiar to the student: it has native and dynamic interest for every normal adolescent.

Laboratory Physiology, as already has been suggested, is an art in itself, a highly technical art, moreover, based on science. Every year it is more practical, applying itself more widely and also in more detail to the needs of practical medicine, and of hygiene, making itself in short more and more useful (never was it by any possibility ornamental).

Recent Advance in Physiology.— Looking back a generation, comparing Dalton's textbook with the latest edition of Howell or of Bainbridge and Menzies, it is clear that the advance in the science as a whole is dominatingly *metabolic*. This indeed was what was lacking 20 years ago to round out the science beyond the organic mechanics which then largely it was. Still considerable progress has been made in neurology, in nutrition, and in the physiology of the skin.

In choosing a dozen or more augmenting topics for mention as of especial import in the advance of physiology, it is almost impossible to suit the tastes of any observer besides the writer! Still, perhaps these subjects are really those that have developed most importantly for science in general:

The more recondite composition of the blood has been very successfully studied by many. Immunity, sera, anaphylaxis, acidosis, etc., are physiologic topics studied mostly by other branches of medicine, but each chemical and not part of the ingenious fairy-story of "ceptors" and so on which originated in Germany. The dynamic factors of the blood have been much developed, especially as the new backbone, so to say, of the newest branch of physiology called by some endocrinology, the science and art of the ductless glands. Much has been learned at Harvard about adrenin and pituitrin and their relations to the dynamic "drives" of the organism — during anger for example. Vasoconstriction, quicker coagulation, antifatigue effect, and an increase of blood-sugar are somehow topics conspicuous in this new work.

Many plant-pollens give special cases of hay-fever because their protein is reacted too violently by the blood-proteins: this is a type of a new group of blood-reactions whose study properly is on a physiologic base.

Fatigue in its more rational aspects (involving the actual living of the actual animal and not the actual dying of some abstracted portion of an animal) has been studied extensively in part as "war-work" toward the maximal production of munitions, etc. Columbia has led in this work here in America.

Integration has been appreciated as never before under the influence of psychology. Less and less attention is paid to the phenomena exhibited by protoplasm in its dying stages — as dying every isolated organ must be. The principle is capable of very much further application still in both theoretic and practical physiology. A materialist, for example cannot be possibly really wise as a physiologist, however good an anatomist he may develop into.

The movements of the alimentary canal, both gross and minute, have been studied with much success. It is beginning to be recognized at last that where contractile tissue is there is movement! The Roentgen rays have revealed some of the complex movements of the gut, 18 years ago, and now the finer movements, e.g., of the villi, remain to be described. Nearly five years ago I called attention to their movement and to one of their possible ulterior absorptive functions: "The 4,000,000 villi of the intestine, rich in smooth muscle and sympathetic nerves as well as in epithelium, probably adapt the blood's content of the nutritive lipoids and proteins to the varying immediate needs of the nerve-cells, and may besides send inward sympathetic influences which, fusing, possibly in the brain, become euphoric."

Dietetics has made strides, especially in the direction of applied economic physiology. The old matter of doubt as to the safe-minimum of protein has not been clarified to everyone's satisfaction.

The integrating *nervous system* has become better known in certain of its functions. The sensory side of the autonomic (itself relatively a recent "discovery") has been developed as Remak's fibres, thus laying more of the physical basis of the subconscious aspects of mind. The cerebral cortex has revealed some of its functions on a basis of psychomotion, especially in the way of restraint. Work has been done on the physiology (vasomotion and keinesthesiology mostly) of sleep. The reflexes have been studied in many directions, practical and theoretic. The senses have been investigated in new ways, on one hand highly technical and on the other practical and popular, a new series of books on the senses helping the latter purpose. Vasomotion has been getting on to a gratifying extent.

The neuro-musculo glandular system, mechanism of efficiency, has received much attention, especially in England and in some of the physical-education schools of America. The all-or-none principle has been of use in understanding many things in regard to skill. The relations of physiology to exercise has been developed in many directions; and those of satisfaction to the dynamic aspects of work — the so-called "stheneuphoric index" or energy-joy ratio. The rehabilitation of one hellwar crippled and shocked is sure to give the psychological physiology of skill a chance to develop far in theory as well as in practice.

Dental physiology has gone on, largely in the directions of electrical and pathological and prosthetic physiology.

The *skin* has been revealing some of its hidden mysteries, and proves to be an organ of pre-eminent general importance to the individual. If I may again repeat part of an article — summary of nearly five years ago:

The integrated epicritic impulses (from the skin and mucosæ) appear to have predominance in human physiologic euphoria, two possible means of stimulation being evaporation and oxidation.

A list of the more or less influential elements of the skin would include the complex vasomotor mechanism; the arrectores pilorum muscles; afferent sympathetic dendrites, the peculiarly efficient epidermis, sweat glands, sebaceous glands; Meissner's corpuscles, the terminal cylinders of Ruffini, tactile menisci, the nerve-rings of Bonnet (?), Vater-Pacinian corpuscles, free nerve-endings, heat-receptors, cold-receptors, pain-receptors, pleasure-receptors, and possibly tickle-receptors.

Air that is dead (i.e., not moving); humid and too warm; humid and too cold; or lacking in oxygen, is a chief occasion of organic dysphoria. Physiologically these conditions are lacks,— lack of movement over the skin, lack of the optimum temperature, lack of dryness (evaporation so being lessened), and lack of dermal oxygen, possible reflex determinant in part of pulmonary respiration.

Arterial tension has been actively studied in many places and is about to reach important practical conclusions as we learn more and more of the intricate controls of vasomotion. A new «continuous,» method has been devised for the study and record (hemobarogram) of the ever-varying blood-pressures termed systolic and diastolic, respectively. From the *Proceedings* of the American Psychological Association (December 1916) the following slightly modified excerpts may be added to indicate the status of one phase of the physiology of blood-pressure at that time. Nine or ten thousand measurements sanction these tentative propositions, as the hemobarograms show:

Arterial stuffing and constriction are very active and variable in all persons. Peripheral arterial tension is by far the most sensitive and easiest index of vasomotor rearrangement correlate to activity mental or bodily. The doubleness of blood-pressure measurement («systolic» and «diastolic») makes possible a partially differential index of activities:

The «systolic» tension represents especially the ever-changing output of the left heart, which latter is quickly variable in size (Gesell) as well as in the frequency of its contraction. The diastolic tension is more dependent on the autonomic vasomotion, direct and reciprocal. Thus the systolic variations are more directly mental, and the diastolic more somatic and vegetative.

The ordinary systolic pressure-range is about 10 millimeters Hg, increasing to 40 or 50 or more in «mental» activity of a somewhat greater intensity. The usual diastolic range is about 8 millimeters Hg, save in old persons, and it has a lower maximum. Vasotension is a ready index of the intellectual and affective psychophysical dynamism («power of concentration») of an individual, and as such has value as a mental test; it is also a useful index of «nervousness» and of mental derangement perhaps.

Aments (except microcephs?) sometimes have a spontaneous systolic range of no more than 2 or 3 millimeters Hg for many minutes at a time, and a mental activity-range of 5 or 10 millimeters. Complete dements exhibit something of the same arterio-stasis but with a tendency to large progressive excitement-rises not observed in aments. One microceph had a large and quick diastolic range and a normal systolic curve. Imbeciles and morons show varying degrees of the systolic plateau more or less according to mental status and dynamism; but there are many exceptions.

No personal, racial, sexual or age-differences in the variability have appeared; each hemobarogram is unique and always an interesting and accurate «human document.»

Sudden mental activity, apparently of any sort (e.g., multiplication, imagination of any kind of personal activity, transfers of the attention-line, attention to the arm-sensations, dynamic associations, unpleasant or pleasant effects); active inhibition; breath-holding, and gradual subconscious increase of psychophysical tonus, increase both the systolic and the diastolic tensions, especially the former; so does physical exertion proper.

Really passive relaxation of the muscles and of the mind; quiet, prolonged recall of happiness; sleep-suggestion; humor; deep breathing, and usually sensations of pleasure not allowed to excite, cause a lowering of both pressures. Marked rises in both tensional phases occur without conscious accompaniment, suggestive if not demonstrative of the subconscious actions of mind. Reciprocal variation of the systolic and the diastolic is very frequent, yet in some cases the two parallel each other for many minutes at a time. True emotion (adrenin and blood-sugar are suggested) lasts much longer than pretended emotion and «causes» (?) more variation.

Imaginary neuromuscular fatigue exerts a strong vasomotor influence. Lapsus attentionis lowers both tensions suddenly and far.

These are some of the chief personal considerations. The medical relations are too complex to be reported; less has been accomplished in this field of application.

Very numerous topics have been developed by physiologists since the preceding revision of this Encyclopedia was made, but these seem to the present writer to be fair examples of the most important directions. The World War will deflect the research-activities of the science into more practical (if not more useful) lines, at least for a time. The average physiologist will then have a broader mind and will realize, often for the first time, that his great and fundamental science, as the one dealing with organic functions, is more than a study of «nerve-muscle-preparations,» that it may be made one of the two foundation sciences of personal human life.

George Van Ness Dearborn,
Medical Corps, United States Army.

PHYSIOLOGY OF PLANTS. See Plants, Physiology of.

PHYSIOLOGY OF TASTE, or PHYSIOLOGIE DU GOÛT. This work may be compared in a distant way to the 'Compleat Angler' of Isaak Walton. It is a similar repertory of information, precept, anecdote and personal reflection, a similar stream of pleasant talk by a charming companion who discourses most entertainingly of what has been, after his business, the most unfailing interest of his life. Its author, Brillat-Savarin (q.v.) (1755–1826), was an honored magistrate and jurist, but his fame rests wholly on this volume of "meditations of transcendent gastronomy," as he calls it with mock grandiloquence and with a humorous reference, perhaps, to Lamartine's 'Poetical Meditations,' which had been the great literary success a few years before. He worked at it affectionately for many years, and only gave it to print, and then anonymously, a year before his death. Its contents are most various. First come 30 "meditations" on such matters as the senses, taste, smell, appetite, thirst, the pleasures of the table, digestion, rest, sleep, dreams, diet, corpulence, fasting, the history of cooking, in which physiological fact and theory alternate with stories of remembered feasts, bits of strange lore from far afield with descriptions of culinary *chefs-d'œuvre* that makes your mouth water, racy anecdotes with practical recipes. Then, as if the meditations had not afforded him latitude enough, he adds 27 *variétés*, "miscellanies." But various as are the contents, they all turn about the business or pleasure of eating. Gastronomy is declared to be the chief of all sciences. "The destiny of nations depends on how they are fed," and "Tell me what you eat and I will tell you who you are," are among the aphorisms which serve as its basis. And the intentional mock grandiloquence of the style and the apparent levity of the author should not deceive us as to the seriousness of the work. There is much in the book, in its intention, at least, to justify the title, "physiology of taste." It was one of the first attempts to approach the spectacle of human conduct from the physiological side. It is perhaps not without significance that Balzac admired it much and afterward wrote a 'Physiology of Marriage' and a 'Physiology of Dress.' However, Balzac recognized that the charm of the book lies, not in the matter, but in the style and in the genial, lively and humorous personality that shines through it. Consult the English translation by Anderson, R. E., 'Gastronomy as a Fine Art' (London and New York 1877).

Arthur G. Canfield.

PHYSOSTIGMA. See Calabar Bean.

PHYTOGEOGRAPHY. See Plant Geography.

PHYTOLACCASEÆ. See Pokeweed.

PI-BESETH, pē-bā'sěth. See Bubastis.

PIA MATER, pī'a mā'tėr the innermost of the three membranes investing the brain and spinal cord. See Brain; Arachnoid Membrane.

PIACENZA, Pietro, Italian clergyman: b. Piacenza, Italy, 21 Jan. 1847. He was educated at Alberoni's College, Piacenza, and ordained to the priesthood in 1869. From 1870 to 1878 he was professor of history and liturgy, at Piacenza Seminary; from 1878 to 1897 he was archpriest and pastor of Fiorenzuola, and after 1897 archpriest of the cathedral of Piacenza. Since 1904 he has been visitor apostolic of Rome and its district, and after 1907 professor of liturgy in the Roman Seminary. Dr. Piacenza has published 'Storia del B. Gregorio X' (1876); 'Quæstiones Liturgicæ' (1887); 'Il Rito della consacrazione di un vescovo' (1899); 'Un curioso documento della giovinezza di Pietro Giordani' (1901), etc., and contributions to *Ephemerides Liturgicæ, Archivo storico,* etc.

PIACENZA, pē-ā-chěn'zā (ancient Placentia), Italy, city, capital of the province of Piacenza; one-third mile south of the Po River; 43 miles southeast of Milan and 35 miles northwest of Parma. It is a fortified city and has always been considered of great strategic and commercial importance. The fortifications are kept in repair and improved from time to time as new defense methods are introduced. The city was founded 219 B.C. by the Romans. About 20 years later it was destroyed by the Gauls. When the Via Æmilia, a Roman military road, was constructed, the western terminus was at Piacenza. The city entered the Lombard League in the 12th century, later fell under the domination of the Visconti, the Sforza, and the popes. In 1545 Pope Paul III presented it together with Parma (q.v.) to his son Pier Luigi Farnese. From then on its political fortunes followed those of Parma.

Among the historic buildings of Piacenza is the ancient church, San Sisto, rebuilt in 1499–1511, for which Raphael, about 1515, painted the Sistine Madonna. This picture was sold, in 1753, to Frederick Augustus of Saxony and is now in the Dresden Gallery. Other noted buildings are the cathedral (1122), in which there are paintings by Guercino, Carracci and others. The church of Santa Maria di Campagna has fine frescoes by Pordenone; the square has some fine equestrian statues. The public library has about 120,000 volumes. The Palazzo Municipale is an impressive building dating back to 1281. The huge, uncompleted Palazzo Farnese, begun in 1558, now serves as a military barrack. It has modern theatres, hospitals and educational institutions. It has considerable manufacturing interests, especially in silk, cotton and woolen goods, pottery, wine, cheese and machinery. In the vicinity are valuable marble quarries. Pop. commune about 40,000. Consult 'Monumenta Historica ad Provincias Parmensem et Placentinam Pertinentia' (8 vols., Parma 1855–60); Giarelli, 'Storia di Piacenza' (2 vols., Piacenza 1889); Jordan, L., 'Die Renaissance in Piacenza' (in 'Archiv für Kultur-Geschichte,' Vol. V, Berlin 1907); Siro Corti, 'Provincia di Piacenza' (Turin 1893).

PIACERE is D'Annunzio's first novel, and was first published in 1889, when he was 26 years old. A more fitting title than the one which the author gave it is that of the English translation by Georgina Harding, 'The Child of Pleasure' (Boston 1910), which in turn was suggested by the still more illuminating and apt title of the French translation, 'L'Enfant de la Volupté.' The story is that of a workless yet wealthy young man of the Italian nobility who has a love for, and succeeds in winning, several women, and who has more momentary affairs with a great many others, all of them, however, of his own class. The two most interesting parts of it are the description of a horse race for "gentlemen" riders, in which the hero races against a friend the love of whose mistress, the wife of a mutual friend, he has appropriated, and the description of the duel on the following day between the winner (of the race as well as of the lady) and the loser, which event interrupts the lovemaking of the former because of a serious wound received. Both incidents are familiar to novel readers. There is no plot. The book is a painstaking exposition of an artificial state of mind and of sensual emotions which it engenders. The attitude toward women therein displayed is not wholesome: they merely present possibilities for material pleasure. The very completeness of its psychological detail renders it at least monotonous, and the normal, healthly mind conceives no sympathy, to put it mildly, with D'Annunzio's hypocritical and obnoxiously aristocratic hero. In workmanship the story does not present a high degree of skill and a number of the links are plainly conventional. However, it must be remembered that it is a work of youth. Consult Sedgwick, H. D., 'Essays on Great Writers' (Boston 1903).

Americo U. N. Camera.

PIAGGIA, Carlo, Italian explorer: b. Lucca, Italy, about 1822; d. Sennaar, Sudan, 17 Jan. 1882. He went to Egypt when young, was with Antinori in Bahr-el-Ghazal 1860; went with Gessi to the lakes of the Nile in 1876 and was the first European among the Nyam-Nyam. His ethnographic collection was acquired by the Berlin Museum. He published 'Dell' arrivo fra i Niam-Niam' (Lucca 1877).

PIANISSIMO, the superlative of piano (Italian for soft and low); piano is used in music in contradistinction to forte. The symbols for these terms are pp. and p. Some composers, especially Verdi, Berlioz and Tschaikovsky use the symbol pppp. and even ppppp. to express that they desire the softest pianissimo possible, while many others frequently indicate this by ppp. See Music.

PIANKISHAW (pĭ-ăn'kē-shâ) **INDIANS,** a small American tribe of the Algonquian family, originally a part of the Miamis (q.v.). The tribe never numbered over 1,000. They removed to the Indian Territory, now Oklahoma, from Kansas in 1867, after selling all their lands in the latter State. They are now known under the name of Peoria, of which in 1906 there were only 192 left, none of whom was of pure blood. Consult Hodge, F. W., ed., 'Handbook of American Indians North of Mexico' (Part II, Washington 1910).

PIANOFORTE, a stringed musical instrument commonly known as a «piano,» and essentially consists of a series of stretched, graded and tuned wires which are struck by felt-covered hammers by the operation of keys conveniently arranged in a keyboard. The term, «pianoforte,» which is the original term designating the instrument, is derived from the Italian «piano,» soft + «forte,» loud; while the term «piano,» usually designated by p., is a sign used in music to denote softness, that is, the strain where the indication occurs is to be played with less than the average intensity. Similarly, pp., or ppp., abbreviations for «pianissimo,» signify very soft.

The pianoforte is probably the most extensively used of all musical instruments. It was evolved directly from the clavichord and harpsichord, which were undoubtedly elaborations of the monochord or pitch-carrier with one string, although even the approximate date or the name of the inventor who first put keys to a monochord and called it a clavicordium is quite unknown. Virdung, in his 'Musica Getutscht,' published in 1511, states his inability to ascertain those facts, although it is well known that Pythagoras, in the 6th century B.C., measured a vibrating string stretched between raised bridges on a resonance box, and by shifting those bridges he accurately determined the intervals of the Greek diatonic scale. It is supposed that Pythagoras obtained the monochord embodying the principle of the stopped string upon a finger-board from Egypt, where it had been known for ages before his time. After Pythagoras, the monochord became, in Greece and Europe, the canon or rule for the measurement of musical sound intervals, and continued to be so employed up to the 11th century, A.D., when it was transformed into a polychord of four strings, to facilitate the melodic division of the Gregorian tones — the Plain-Song of the Church as used in the Ritual, and were known under a great variety of names such as clavichord, clavicordium, spinet, virginal and regal.

The early clavichords had a compass of four octaves. The natural keys were made of citron wood and the sharps of ebony. The damper was a narrow band of felt attached with glue to the hitch-pin block, opposite to the wrest-pin block, and the bridge was curved. As they were strung with wires in equal lengths, they were for a long time regarded as sets of monochords, the scaling being effected by the line of the tangents attached to the keys on the left-hand side of the player, while the three or more sounding-board bridges rested upon the narrow belly on the right. Owing to the length of the scale the longer instruments were not capable of being tuned higher, giving them a weak but delicate tone which responded to the gradations of the player's touch. The tangents were upright blades of brass fastened into the keys and beaten out at the top so as to touch equally the one string or the two or three unison strings forming a note. The tangents thus constituted a series of bridges or sound exciters, and each of the little groups of strings thus formed was acted upon by two or sometimes three or four tangents to obtain as many notes. The damping was contrived with a cloth interwoven among the strings behind the line of tangents. This cloth instantly dampened the vibration of the strings when the finger released the key and the tangent quit the string.

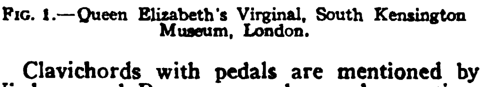

Fig. 1.—Queen Elizabeth's Virginal, South Kensington Museum, London.

Clavichords with pedals are mentioned by Virdung and Reynvaan, and are also particularly described by Adlung, indicating that some of the instruments had two octaves and a note of pedals attached to a separate clavichord pedalier and «fretted,» there being three strings in the lower and four in the upper range for each pedal note. The terms virginal or spinet generally indicate one and the same instrument without regard to form of construction, but practically limited to a plectrum (jack) clavier with one string only to each note (see Fig. 1). Its earliest recorded name is the clavicymbolum, occurring in the rules of the Minnesingers under the date of 1404. It is the Latin for psaltery, an instrument of the dulcimer kind, to which a keyboard was added and suggests an ecclesiastical or monastic origin. Virginal was the English name of the spinet, and was so called probably on account of its appropriateness for girls as compared with the contemporary lute which was a more difficult and manly instrument, rather than the assumption that Queen Elizabeth was a skilful performer on it, especially as the name was current in the reign of her grandfather, Henry VII. According to Scaliger, who wrote in the latter part of the 15th century, the name spinet is derived from the little quill point or plectrum, as an improvement upon the instruments previously known as monochordum and harpsichordium, a keyboard psaltery of harp shape. On the other hand, the Italian expert, Signor Ponsicchi, attributes it to a Venetian maker, who signed and dated an instrument of this kind «Ioannes Spinetus, Venetus Fecit; A.D. 1503.» The virginal that is associated with Queen Elizabeth is now in the South Kensington Museum, London, and may be described as an Italian pentagonal spinet (see Fig. 2). Italian spinets were made of cypress wood, and as the utmost vibration was sought for by the makers, both case and belly were constructed of that material. They consisted of two cases — the inner rough, but possessing a free and satisfying quality of tone, while the outer received great care in workmanship and was often beautifully decorated. The pentagonal or heptagonal spinets had false cases like the clavicumboli or harpsichords, from which they could be removed when required for performance, while the oblong Italian makes were inseparable from the outer case like the modern pianos. Until the 17th century, the keyboard was usually an external addition to the case, when Rosso, a Milanese maker, set it back into the body of the instrument, a recessing which was generally copied afterward (see Fig. 3).

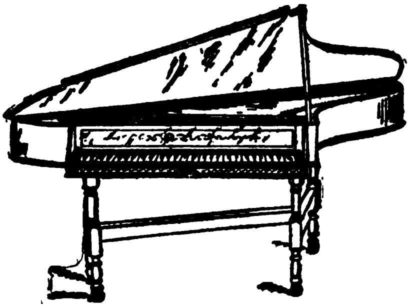

FIG. 2.—Spinet — 1710.

The harpsichord is a double, treble or quadruple spinet, the sounds being excited by a jack and quill plectrum, as in the case of the virginal or spinet. More exactly stated, instead of having one string to a note, as in the virginal or spinet, it has two, three and sometimes four strings to a note, which, with the exception of the common features of the case, sound-board, wires and keyboard, it differs entirely in sound, excitement and effect from the clavichord. It has an individuality of tone not possessed by the pianoforte, and a brilliancy of effect beyond the capacity of the clavichord, but in expressiveness depending upon touch its power is much less than either.

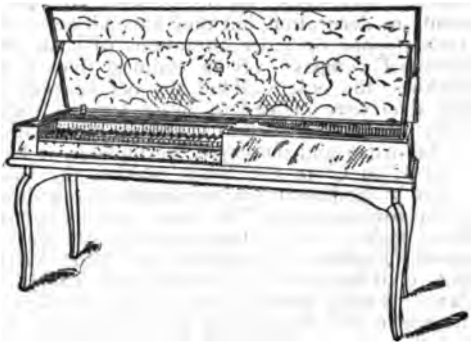

FIG. 3.—Clavichord, Taphouse Collection, Oxford.

The harpsichord was a much favored musical instrument during the 17th century, occupying the place now filled by the grand piano, and while not so much a solo instrument, it was of considerable importance in the orchestra, its player generally assuming the responsibility of conductor. The complex character of its mechanism required a larger and differently shaped case to that of the spinet and prefigured that of the grand piano, the wing-shape giving rise to the German name fluegel, also kielfluegel, from the plectrum (kiel, quill) producing the sound. With the Italians—it was known as the clavicembolo, while the French called it clavecin. In the English term harpsichord, the harp disposition is recognized in contrast to the trapeze shape of the spinet, which appeared about the same time — the earlier part of the 15th century.

The description of a very fine example of a Roman harpsichord in the South Kensington Museum, London, inscribed and dated «Heironymus Bononiensis Facietat Romae, MDXXIX,» will serve to illustrate the general character of the instruments of that time. It has one keyboard and two unison strings to each note; boxwood natural keys, with an apparent compass of nearly four octaves, E to d^3, which by a short octave in the bass becomes C to d^3. In the Italian instruments no change of power was attainable by stops, while the pedals, as in the Trasuntino harpsichords, controlling a sordino for muting, were a very late addition (see Fig. 4). The highest credit for excellence in the manufacture of harpsichords belongs to the

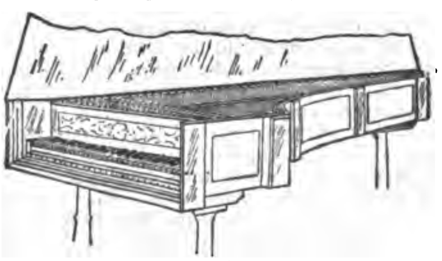

FIG. 4.—Trasuntino Harpsichord — 1531.

famous Ruckers family of Antwerp. The earliest instruments made by them bear the date of 1590, and the latest 1659, a short period of splendid work. Of their instruments there are 70 existing specimens, including some of great beauty of decoration, but they have all been subjected to one or more alterations of scale and keyboard compass. It is claimed that Hans Ruckers, the elder, added the octave register and steel wire instead of brass for the treble notes, designed a second keyboard in imitation of the organ and increased the number of keys from E to C^8 to C-c, thus making the short octave in the bass a long or chromatic one down to the lowest notes. The most famous harpsichord makers of the 18th century were Burkat Shudi (Burkhardt Techudi) and Jacob Kirckman (Kirchmann) in London, and Taskin in Paris. Burkat Shudi began business in 1732 in the house still occupied by his descendants, the Broadwoods, 33, Great Pulteney street, Golden square, London; while Kirchmann continues to be represented by his descendants in a first-class London pianoforte manufactory.

About this time, makers, more or less controlled by the prevailing style of domestic furniture, substituted the more rigid cases of walnut and Spanish mahogany for those of resonant cypress, cedar and pine, and thus obtained a greater power and majesty of tone, while a greater variety of tone was derived by a freer use of the stops. To the three shifting registers of jacks of the octave and first and second unisons, Van Blankenburg's lute stop was added, which by plucking the strings in the lower and medium divisions of the scale, close to the bridge and much nearer the treble, produced a charmingly delicate, reedy tone quality very much like that of the mandolin. Finally, to obtain «crescendo» and «diminuendo,» a swell was introduced, which consisted in gradually raising a hinged portion of the cover with a pedal. This invention of Roger Plenius was probably suggested to him by the nascent pianoforte which appears to have been first made by him in England.

Although references to the pianoforte occur in the correspondence of musical instrument makers during the latter part of the 16th century, as, for example, in the letters written by Hippolito Crica or Paliarmo, dated 27 June and 31 Dec. 1598, and addressed to Alfonso II, Duke of Modena, the first true pianoforte, as now understood by that term, was invented by Bartolommeo Cristofori, a Paduan harpsichord maker, in Florence about 1709. At that time kings and princes well disposed toward music were accustomed to keep large collections of musical instruments to be used in connection with their domestic and courtly festivals, and to keep such instruments in playing order it was necessary to employ men possessing the requisite ability. It is of record that Cristofori was engaged in that capacity by Prince Ferdinand dei Medici, and while thus employed invented and produced the pianoforte. The record of this invention is given by the Marchese Scipione Maffee, under the date of 1711, in a description which appeared in the *Giornale dei letterati d'Italia*, a publication conducted by Apostolo Zeno. It gives the information that in 1709 Cristofori had completed four «gravecembali col piano e forte› — keyed psalteries with soft and loud, three of them having the long or harpsichord form. There are two grand pianos still in existence, made by Cristofori, and dated respectively 1720 and 1726. They are of a very perfect construction, and embody all the essentials of piano movement. The first belonged to the Signora Ernesta Mocenni Martelli of Florence, and was acquired by Mrs. J. Crosby Brown of New York in 1895 for presentation to the Metropolitan Museum of Art of that city. It has a compass of four and a half octaves, $C–f^3$. The second belongs to the Commendatore Alessandro Kraus of Florence. Their actions are similar, and show that Cristofori succeeded in satisfactorily solving the problem of escapement, and had also provided for repetition without a double escapement. Fig. 5 is a complete diagram of this action: (k) is the key; (h) the hopper or movable tongue; (n) the notch for the hopper beneath an underhammer or escapement lever (l), which being covered with leather upon the end operates to raise the hammer butt (d); (e) is the hammerhead; (s) the spring regulating the play of the hopper or distance between it and the string and regulated by a small hopper check (w); (f) hammer check; (g) damper, and (j) damper stop. It appears that in this action, Cristofori retained the shallow measure of an Italian harpsichord, and consequently inverted his wrest-plank (the block in which the tuning-pins are held), which had to be much stronger than in the harpsichord, owing to the increased thickness of the strings which were required to stand the impact of the hammers, and attached the strings beneath. The pins pierced the wrest-plank so that the tuning was accomplished harp fashion. His instruments ranged in compass from four to four and a half octaves. The essential features of Cristofori's action were adopted by Gottfried Silbermann, the great organ builder and clavichord maker of Dresden. He made two pianofortes, which he submitted to J. S. Bach, who disapproved of them on account of their weak treble and heavy action. Recognizing that he had not attained the requisite skill to reproduce the excellent quality of his models, he devoted several years to experiments, and finally submitted another to Bach, which met with the great composer's approval. It is a fact, however, that the elder Bach never really adopted the pianoforte, and that all of J. S. Bach's compositions for the clavichord and harpsichord, no less than those for the organ, have to be virtually transcribed in the rendering when transferred to the pianoforte. This fact is very clearly shown in Czerny's edition of the ‹Forty-eight Preludes and Fugues.›

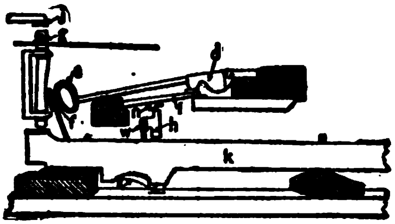

FIG. 5.—Cristofori's Action.

The Seven Years' War (1755–62) terminated Saxon pianoforte making, and scattered the workmen, some of whom found their way to England and made a fresh start in the business.

Up to 1760, all pianos had been built in the shape of the modern grand, horizontal or upright; but, between 1760-65, Johann Zumpe, a former workman in Shudi's establishment, introduced the English square piano. The action was sufficient, although almost rudimentary, and contained what was called the «old man's head,» a metal pin with a leather knob on the top to raise the hammer, and the «mop-stick» damper raised by a simple jack. The compass was five octaves from F–^{4}. Zumpe's success was immediate. The instruments sold rapidly, and the form increased in popularity. Other makers started establishments, and in the last decade of the century, London became the centre of the world's pianoforte trade, with not less than 30 square piano-making establishments, English and German, in active operation.

Between 1780 and 1790, John Broadwood recognized the fact that when the string was struck at a certain point, it yielded a fuller tone. He, therefore, adjusted the hammers so as to obtain this result, and also transferred the wrest-plank to the back of the case, and introduced the two pedals — one to raise all of the dampers, and the other to soften the tones by dropping a piece of cloth over the strings. The change in the place of the wrest-plank enabled him to reduce the inordinate length of the unused wire, and also to straighten the keys, which had been hitherto left more or less twisted, as in the clavichord, but in connection with the crank damper, he did not get beyond the «old man's head» device that lifted the hammer, and the merit of introducing in the square piano the «hopper» — a jack with a string working in a notch forming the front part of a lever, technically known as the «under-hammer» — belongs to John Geib, who took out a patent for the improvement in 1786, and first applied it to the square pianos he made for Longman and Broderip, music publishers in Cheapside.

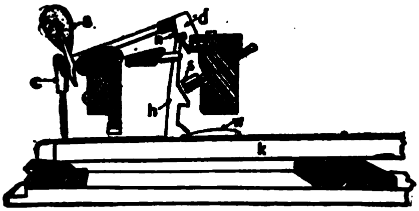

Fig. 6.— Broadwood's English Action.

Fig. 6 shows the Broadwood grand piano action, commonly known as the «English direct lever action,» in which the key (k) on being depressed raises the hopper (h) which strikes in the notch (n) cut in the butt of the hammer (d), the play of the hopper against the notch determining the velocity of the hammer and the individuality of the player's touch; (w) is the wire hopper check; (s) the screw that regulates the lever to determine the distance of the hopper motion; (a) is the hammer-head, and (c) the check which is raised when the key is depressed and arrests the hammer in its fall. It is the first simple contrivance for repetition, that is, for repeating the blow of the hammer before it returns to its original position or equipose. The key not only raises the hopper and check, but also the damper, so as to allow the string forming the note to continue the vibration, and the escapement when raised without impact as depends upon that space between the hammer and the strings, to allow the hammer to clear them under a blow either soft or loud, and thus prevent the strings stifling the vibration before it has had time to become a musical note. This action was invented about 1772, and was further developed and perfected by Broadwood, with the assistance of Backus and Stodart, until it became the best single escapement action.

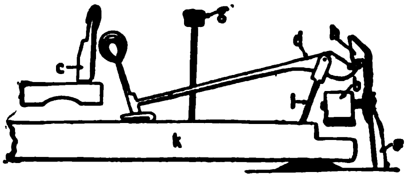

Fig. 7.—Streicher-Viennese Action.

About 1777 the German manufacturers produced another kind of escapement, which was considered favorably by prominent pianists for many years. It was invented by Stein, a pupil of Silbermann, but was carried to its highest state of perfection under the joint efforts of his daughter Nannette and son-in-law, Andreas Streicher, about 1794. Fig. 7 shows the construction of this action: (k) is the key, (h) the hopper, (s) the hopper spring, (l) the standard in which the hammer butt (d) is centred, (b) the set-off button, (c) the check and (g) the damper. This action differs from the Cristofori (English) action, in that the hammer is directly attached to the rear end of the key itself, instead of being fixed to a lever independent of the key. This arrangement caused a change of axis of the hammer when the key was struck, thus giving the extreme lightness of touch which enabled easier execution and brilliant playing, although less capable than the English of producing its tone varieties. Up to 1777 the French imported their pianos chiefly from England, when Erard (Erhardt), a German pianomaker, produced the first piano made in France. Having been driven to London by the Revolution, he familiarized himself with the English methods, and incorporated the English principles in his first instrument. Subsequently he adopted the Stein principle, and afterward developed his own action, illustrated by Fig. 8, in which, when the key (k) is depressed, the lever (l) is raised by the pilot (p), and the hopper (h) escapes forward when it has delivered its blow to the roller (r) beneath the hammer fork (f). Similar to the notch of the English action, the roller transmits to the hammer the player's intention and individuality. A prolongation of the hopper forms the escape-

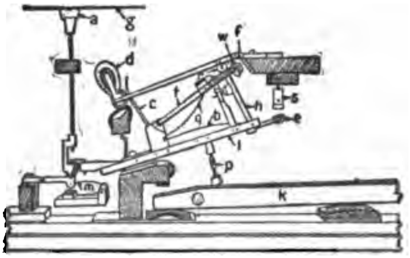

Fig. 8.— Erard's French Action.

ment lever (e) which controls the set-off from the strings by the screw and button (s). The wire hopper spring (b) maintains the hopper in position, and together with the hammer-head (d) and the check (c), completes the single escapement action. The repetition or second escapement is obtained by the roller resting upon the hinged repetition lever (t) which rises when the wire spring (q) is bent by the depression of the key, the rise of the lever being controlled by the screw (w), which acts on the point of the lever.

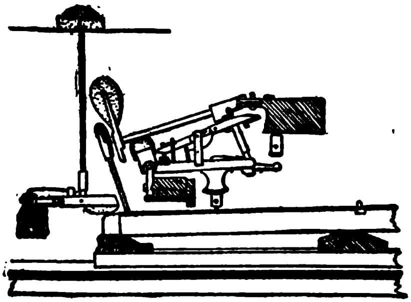

Fig. 9.—Herz-Erard Action.

Under this arrangement, no matter how slowly the key is depressed, the action produces sound, and also enables the hopper to repeat a blow with a partially risen key. The damper (a) is beneath the string (g) and is pushed up by the spring (m). This double escapement action was invented by Sebastian Erard and patented by his nephew, Pierre Erard, in 1821, but did not succeed in obtaining public recognition until after 1835. While not demanding as high a finger movement as the English action, it is uniform in the variety and directness of blow.

The Herz-Erard repetition action shown in Fig. 9 is a simplified form of the Erard action just described. It was first employed in the grand pianos of Henry Herz of Paris, but, owing to its economy and efficiency, has been adopted with slight modifications by many of the most prominent piano-makers. Next to Erard the most prominent piano manufacture in France was Pape, a native of Hanover. In 1827 he invented a down-striking action, of which the mechanism was above the strings. During the latter part of the 18th century the desire to save space originated the idea of making musical instruments of this class in an upright form. The first attempts were merely to turn the horizontal pianos, spinets and harpsichords into a vertical position on a stand. In the year 1800 John Isaac Hawkins, an Englishman, living in Philadelphia, Pa., invented the first genuine upright piano and patented it in the United States and England. He called it the Portable Grand Pianoforte, and it is remarkable as containing most of the features characteristic to the modern upright. The idea was further developed and improved by Southwell in 1807, who produced the now obsolete but beautiful toned "Cabinet," and by Wornum, who produced a low upright with diagonal strings, in 1811, and one with vertical strings in 1813.

Fig. 10 shows the Wornum upright piano action, as made by Broadwood: (k) is the key, (b) the hopper, (d) the hammer-butt, holding the shank of the hammer-head (e); (c) is the check, (f) the damper, (i) the set-off button, (l) the spiral hopper spring invented by Bord, (m) the pilot, employed to raise the hopper and its crank to the height required for their service, and the tape (n), which, being tightened by the rise of the hammer when the key is struck, pulls the hammer back when the key returns and thus assists the repetition. Because of the small floor space occupied the upright piano became the instrument for the million, but it can never be the choice of the artist, because it smothers the vibrations, which can be brought out fully in a grand piano.

A modern piano consists of the following parts: (1) The "case," made of rosewood, mahogany, walnut, cherry, maple or other hard wood, and, according to its form, classified as grand, square or upright. The grand pianos are triangular in body and are built in various sizes, from the full concert grand, 8 feet 10 inches in length, to the baby grand, six feet long, and adapted to parlor use. The square form is no longer built, having been entirely superseded by the upright for use in private houses. The outer side of a piano case is usually veneered over the solid wood. Some makers build their piano cases of material made of several thicknesses of wood, under the supposition that it assists the resonant qualities. Some cases are very elaborately carved and others expensively inlaid. Special instruments have been made costing as high as $50,000. (2) The "frame," now almost universally made of iron or steel, held within the case and inseparable from it. (3) The "string-plate," attached to the rear end of the frame and to which the strings are fastened. (4) The "wrest-plank," attached to the front end of the frame and holding the tuning pins, around which one end of the strings is wound, so that their tension is regulated by turning the pins. The wrest-plank has to be made very solid to ensure the rigidity necessary to withstand the enormous strain of the strings, a tension amounting to from 10 to 20 tons.

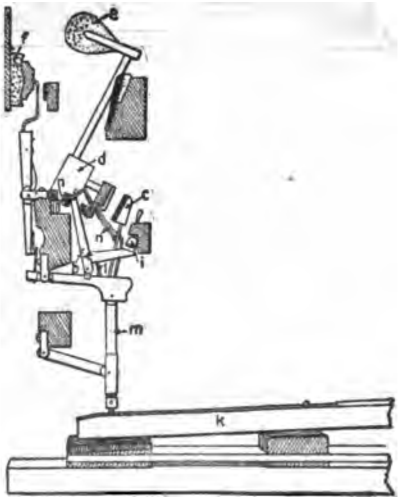

Fig. 10.—Wornum's Upright Action.

(5) The "belly" or "sounding-board," a thin

piece of wood placed under the strings to increase the sound produced by their vibrations. Owing to their small diameter and consequent limited contact with the air, the sound produced by strings vibrating freely is so weak that a resonance factor is necessary. This factor is supplied by the belly upon which hardwood bridges are glued, which transmit the vibrations of the strings to the belly and thus creates sympathetic vibrations of the woody substance so as to adequately increase the sound. The manufacture of sounding-boards is an important branch of the industry and elaborate planing and glueing machinery is utilized.

(6) The «strings,» made of steel wire, one end of each being fastened to the string-plate and the other coiled around tuning-pins in the wrest-plank. They increase in length and thickness from the treble to the bass. In the bass, in order to make the rate of vibration slower, they are over-spun or wound around with fine copper or mixed-metal wire. For the lowest tones (A_2–F_1) only one wire is employed; for each tone (G_1–C) two strings; and above that, three strings. One of the most remarkable differences between the modern and old pianos is due to the vast increase in the tensile strength of piano wire drawn under modern methods. The breaking strength of English piano wire ranges from 225 pounds for No. 12 music, 0.029 inch diameter, to 650 pounds for No. 22, 0.052 inch diameter; giving an ultimate tensile strength of 340,000 pounds to the square inch, about five times that of the best old hand-drawn wire.

(7) The «actions,» the principal varieties of which have already been carefully described, and which consist of the entire mechanical device by which the hammers are propelled against the strings, including the keyboard and its row of keys, which are manipulated by the fingers. The keyboard of a modern piano has a compass of seven octaves, A–A, or seven octaves and a minor third, A–C, the extreme notes of which are very near the limits of the power of the average human ear to distinguish musical sounds. Cristofori's pianos were four-octave instruments. The keys corresponding to the natural tones and called «naturals» are made of ivory, and those corresponding to the chromatically altered notes and called «sharps» are made of ebony. They are shorter than the naturals and are raised above them. When a key is pressed down its rear end rises and lifts the «jack,» which throws the hammer against the strings. The hammers are attached to shanks of light wood, such as pear wood, hickory or white beech, sufficiently tenacious not to fracture under the hardest blow, and yet elastic enough to rebound. The wooden hammer-head is covered with felt, of compressed sheep's wool, cut from one piece, and increasing in thickness from treble to bass. The texture of the felt should be neither too hard nor too soft. A hammer with a hard surface leaves the strings immediately after contact with it and allows the very dissonant upper partial tones to run their course, while a hammer with a soft surface clings slightly to the string, or at least long enough to damp such discordant partials. Simultaneously with the throw of the hammer the «damper» is raised, thus allowing the string to vibrate freely, but by a «check» which prevents its rebound. the damper remains raised as long as the key is pressed down and the string continues to vibrate.

(8) The «pedals,» a set of levers, usually two in number, which are pressed down by the feet. They are called the «piano» and «forte» pedals; some makers add a third called a tone-sustaining pedal. The left foot presses upon the «piano» or soft pedal, which either throws all of the hammers nearer to the strings so that the striking distance is lessened by one-half, or by shifting the keyboard action bodily, removes the stroke of the hammer from three to two strings, one being left unstruck, but not silent, since it vibrates in sympathy with the sounding strings with which it is in tune. This sympathetic vibration gives a beautiful æolian tone quality that has been recognized by modern composers from Chopin to Liszt as of much advantage. The «forte» or loud pedal is pressed by the right foot and raises all the dampers so that the strings struck continue to vibrate even after the keys are released. The «tone-sustaining» pedal, although not invented by the Steinways, is often found in their grand pianos. It is an arrangement that, instead of raising all the dampers, allows the player to prolong any note or group of notes by keeping raised only such dampers as are raised by the keys when the pedal is down. In many upright pianos a soft pedal (Celeste) is applied by mechanically interposing a strip of thin felt between the hammers and the strings, thus materially diminishing the sound, and affording a great convenience in practising.

The earliest compositions for the pianoforte appear in a volume entitled ‘Sonate da Cimbalo di Piano e Forte, detto volgarmente di Martellatti.’ Dedicato a Sua Altezza Reale. Il serenissimo D. Antonio Infante Di Portogallo, e Composto da Lodovico Guistini di Pistoia. Opera Prima, Firenzi, 1732, the year after Cristofori died. The first compositions which showed a technique characteristic of the pianoforte are the three sonatas by Muzio Clementi, published in 1773. From that date the composers studied the new instrument and employed the proper technique, with the result, as in the case of Beethoven's magnificent pianoforte compositions, that they went beyond the capabilities of the instruments of that time, and stimulated the piano-makers to increase both the compass and the power of the instruments. Increase in the power of tone demanded strings of greater thickness, while the extension of scale called for an increased number of strings, and, consequently, an enormous increase in the tension strain on the frame. These conditions led to the use of metal for frames, beginning with the hollow metal tube framing patented by Allen and Thom in 1820, followed by the cast-iron frame of Babcock of Boston, in 1825, and the improvements of Jonas Chickering, who introduced the full iron frame in 1837. Then came Steinway and Sons, who in 1859 introduced the overstrung scale, permitting a much larger number of wires in a small space; thus the modern pianoforte was developed to its present state of perfection and power (see Fig. 11).

Some of the men who have made the piano history of America are Jonas Chickering, the pioneer, whose place in the trade was later filled by Thomas E. and C. Frank Chickering; George and Francis Bacon; James A. Gray, William Boardman, A. H. McPhail, E. N. Scherr, Henry Lindeman, H. C. Schomacker, Ernest Knabe, Henry Hazleton, Hugh Hardman, Napoleon J. Haines, Albery Weber, Henry E. Steinweg (later Steinway), Charles, Henry and C. F. Theodore Steinway, William and Albert Steinway, T. A. Heintzmann, F. G. Smith, Myron A. Decker, Hugo Sohmer, Frederick Mathushek, William E. Wheelock, Simon Krakauer, W. B. and H. B. Tremaine, Edwin S. Votey, W. W. Kimball, Edwin S. Conway, Rudolph Wurlitzer, etc.

An important modern invention is the æolian attachment, by which a current of air is directed against the strings to reinforce the vibrations. Considerable increase in the volume and duration of the tone is thus obtained. Of course the device was not available until it became customary to use a small motor or a bellows for power. Another invention for obtaining an æolian effect was brought out in 1891 by Eisemann of Berlin, who introduced electromagnets placed close to the strings. The pressing of any of the keys closed electric curcuits, energizing the appropriate magnets and enhancing and sustaining the vibrations of the notes affected. This device had the novel effect of altering the tone of the piano so that the strings gave sounds resembling harp strings.

Of devices embodying dumb keyboards for practising purposes, the «digitorium› or dumb piano, consisting of a portable box equipped with five keys supported on springs, and the «practice clavier» invented by Virgil of New York in 1883, are the modern representatives of a very old idea. The use of the former has been severely condemned by good musicians; but the latter, which possesses a complete keyboard, is of great use in the practice of a legato touch. The mechanical arrangement affords two audible clicks — one when a key is pressed down and the other when it is released, so that the only observation required of the performer is to note that the two clicks caused by the depression of one key and the release of the next coincide. The apparatus may be so adjusted that the action can be regulated at will, from the lightest, two ounces, pianoforte touch, up to a touch exerting a pressure of 20 ounces. Its use is of great advantage in acquiring strength of the fingers and for purely technical exercises.

The mechanical or automatic piano had its origin in an adaptation of the perforated cards of a Jacquard loom, in which the holes are positioned so as to direct the disposition of the threads in a pattern. The earlier patents for the use of this principle for playing the keys of a piano were by Seytre of France, Bain of Scotland and Pape of Paris. The principle is applied by means of a continuous roll of stout paper in which are holes or perforations positioned so that as the roll is unwound air is permitted to pass through the holes to the tubes indicated, thus being directed to operate the right piano keys at the correct time. Electromagnets have also been employed to make the connections between the perforated roll and the keys, but as a rule the modern automatic pianos and player-pianos depend on a bellows-pump and the resulting air-pressure or suction to strike the keys and operate the instrument.

The first markedly successful machine involving this principle was made as an attachment to a piano and named the «Pianola» (see Fig. 12). This is placed in the front of the piano so that its «pneumatic fingers,» usually 65 in number, will strike the keys of that instrument. It is operated by means of pedals, levers, the tempo regulator, pneumatic action and perforated music rolls. It possesses the great advantage in that the player can exercise a certain control over expressive interpretation of musical work, by automatically developing the phrasing indicated in the score, which is to music what punctuation is to literary work. To this capacity is added that of fine dynamic shading and variations in tempo, productive of tone-color and accent. The touch of the pianola is produced by the action of jets of compressed air, which act on the keys of the piano, and is as nearly like that of human fingers as it is possible to obtain by mechanical means. The air being exhausted with greater or less suddenness furnishes a pliant and resilient quality that affords a range — from the soft velvety legato to a blow as powerful as that exerted by Liszt or Rubinstein. The tempo-indicator is used in accordance with the system of markings on the perforated roll music, so that the piece is played exactly in the time intended by the composer. The time-shading of the various passages being prescribed by the metronome, perfect time is obtained by simply moving the tempo-lever back and forth upon a dial marked from 0 to 130, to accelerate or retard the movement. It is also equipped with a forte-lever, to still further sustain and control expression.

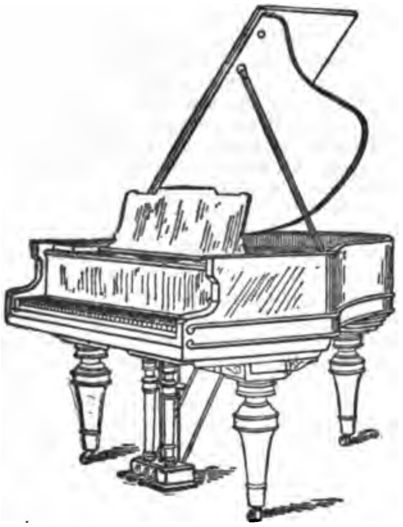

Fig. 11.— Small Grand Pianoforte.

The immense sale of the pianola led piano-makers generally to seek to incorporate its principles into their machines, and hence arose the player-piano, which type of instrument has so taken the market, that the demand for an old-style hand-played upright is rapidly reducing. Each of the leading manufacturers brought out some form of player-piano that would play music furnished in the roll, and at first each gave a special name to his product. But as there was little difference in the mechanisms, the public came to pay less attention to the trade names, and all these instruments have come to be classed as player-pianos. After a time it became obvious that it was to the interest of the trade to have a standard width of music roll, so that music could be run on any player-piano, and a trade agreement was entered into to that effect between leading manufacturers. The typical player-piano has a bellows, operated usually by foot-pedals like those of parlor-organs; also a compensating or equalizing device to govern the air-pressure, which is very necessary; a series of air-tubes to which a current is admitted when a perforation of the traveling music-roll uncovers the desired valve; a motor (which may be based on the bellows-power) for moving the paper roll, and a tracker-mechanism for utilizing the air-pressure or vacuum, to strike the keys of the piano itself. There are also controlling levers for regulating the time, by allowing the roll to move slower or faster; also for rewinding and for producing the expression. Large player-pianos are made on this principle and fitted with electric motors for use in furnishing automatic music in «movie» theatres, on shipboard, etc., these being commonly called automatic pianos.

FIG. 12.—Pianola in operation.

In 1914 there were manufactured in the United States 183,368 pianos, of the total value of $62,775,000, this being a slight reduction as compared with the production in 1909, though a gain of over 30 per cent as compared with 1904. The production of player-pianos in 1914 attained two-fifths of the total value, and in 1918 it is estimated that the majority of the pianos are made either with a player embodied in the design or with such attachment. The annual production of music rolls for such pianos in 1918 was over $1,000,000. During the period between 1909 and 1914 the number of upright pianos made in the United States for or with player attachments increased from 34,495 to 88,078, or by 154.6 per cent, and their value increased from $9,275,001 to $20,892,514, or by 118.5 per cent. The number of grand pianos made for or with player attachments increased from 21 in 1909 to 831 in 1914, and their value increased from $28,900 to $413,665. The output of player-pianos in 1914 included 3,352 automatic pianos, valued at $1,373,206.

There were 255 piano factories in the United States in 1914, giving employment to 24,000 persons and paying out nearly $16,000,000 in wages. They purchased that year nearly $30,000,000 of materials, adding $33,000,000 value in process of manufacture. The leading States in the piano manufacturing industry are Illinois, Indiana, New York, Massachusetts, New Jersey and Michigan.

Bibliography.— For further modern information consult Spillane, 'History of the American Pianoforte' (New York 1890); Hipkins, 'History of the Pianoforte' (London 1896); Rimbault, 'History of the Pianoforte' (London 1860); Paul, 'Geschichte des Klaviers' (Leipzig 1868); Bie, 'History of the Pianoforte and Pianoforte Players' (London 1899); Bluethner and Gretschel, 'Lehrbuch des Pianofortebauen' (Weimar 1886); White, 'Theory and Practice of Pianoforte Building' (1906); Dolge, 'Pianos and Their Makers' (1913); Van Atta, 'Treatise on the Piano and Piano Player' (1914), and for information of the earlier type, consult Schlick, 'Spiegel der Orgelmacher' (Mainz 1511, Berlin reprint, 1869); Virdung, 'Musica Getuscht und ausgezogen' (Basel 1511, Berlin reprint 1882).

PIANOFORTE INSTRUCTION, Methods of. The word «method,» as applied to pianoforte instruction, may be used in a double sense. In the first place it may refer to the current collections of exercises and pieces which are used for the teaching of beginners; in the second place it may refer to modes or principles of instruction. We shall use the word only in the broader sense. To be sure, the two meanings overlap to a considerable degree. A plan of instruction is generally embodied in books intended for the guidance of pupils, and collections of the kind mentioned are likely to contain suggestions of a pedagogic nature in addition to the material they offer for practice. Methods have been numerous, and it cannot be our purpose to go into a detailed enumeration and consideration of them. Nor will it be necessary. For most of the systems of former days have been superseded by later ones, so that an examination of the former would have only a remote, historic interest. Among the more important systems of the first half of the 19th century were those of Logier, Kalkbrenner and Czerny. A peculiarity of the Logier method was its employment of the mechanical device known as the chiroplast; likewise the simultaneous teaching of many pupils. Kalkbrenner used a modified form of the chiroplast, called the hand-guide. Czerny was the pedagogue who especially promoted the technical side of piano playing. Many of his études are classical and are still in use among teachers. Plaidy had the same end in view in his well-known 'Technical Studies.' It is peculiar that the individuals in whom pianoforte virtuosity found its culmination — including Liszt, Tausig, Bülow and Rubinstein — should have given us no methods of instruction. Tausig, to be sure, left a collection of valuable studies, a feature of which is the persistent use of certain fingerings, unobstructed by the presence of black keys. And Bülow has likewise embodied some novel ideas on fingering in the editions flowing from his pen. But nothing approaching a system or method was left by any of these men. The more important methods of recent times are those of Köhler, Deppe, Leschetizky, Mason and Virgil — the two latter being the product of American thought. The Köhler method is careful and betrays great pedagogic ability; but it is somewhat dry and lacks important features which are the result of more recent insight. Deppe's method lays great stress on ease and freedom of movement and advocates co-operation of the arm in playing. His maxim is: «If it looks well, it is right.» Leschetizky has been famous as the teacher of a great number of eminent pianists. In consequence his system has gained wide celebrity. An examination of the same, however, as outlined by some of his assistants (Brée, Prentner), fails to reveal any startling innovations and so we are inclined to attribute his success to personal qualities as a teacher rather than to peculiar secrets of system. Mr. Mason may be regarded as the Nestor of American teacher-virtuosos. He published a method entitled ‹Touch and Technic,› which is very popular on this side of the Atlantic. Opposed to the stiff finger and wrist playing of former days, he aims particularly at beauty of touch. Like Deppe, he lays stress on arm movements, his analysis of the same being especially illuminating. He likewise developed an ingenious method of practising scales and arpeggios in various rhythms and tempos. The Virgil method is unique inasmuch as it makes use of the dumb piano called the Practice Clavier. Tone is here replaced by clicks, which can be produced both by the up and down action of the keys. Likewise the force necessary to depress the keys is subject to regulation. Special printed instructions of a very detailed nature are supplied for the guidance of teachers and pupils.

In general, the tendency of modern instruction has been toward freer and more natural movements and specifically toward a more liberal use of the arm. Playing in the older days was comparatively stiff. It proceeded mainly from the fingers and wrist and the members not directly involved were supposed to be held quiet. This has been changed of late: the old hammer-like touch of the fingers is having its supremacy disputed by touches that depend more on pressure, while the arm and forearm are constantly being brought into play. Even the time-honored motion of the thumb under the palm of the hand, in performing scales and arpeggios, is no longer insisted on so rigorously, and deft arm-movements are coming into the foreground.

Among the foremost innovators in this movement is Rudolf M. Breithaupt. He has published a voluminous treatise entitled ‹Die natürliche Klaviertechnik,› which is searching in its analysis and replete with excellent suggestions. Among other things, Breithaupt abandons the traditional wrist stroke, and his playing of scales is accomplished by means of hand and forearm movements, with the minimum passing under of the thumb.

While this is not the place to pronounce judgment on methods, we may refer to the consensus of modern opinion in favor of freer and more natural movements and liberal co-operation of the arm. The results which have been arrived at are based on careful analysis and seem destined to become permanent. Among the future advances to be expected in the field under consideration is the application thereto of psychological methods. Hitherto very little has been accomplished in this direction. Yet there is hardly a field which is more favorable to the work of the psychologist. The exact determination of the best playing motions, the regulation of practice hours, the testing of pupils for musical talent — these are but a few of the many things with which psychology would be competent to deal. There is no doubt that this work will soon be taken up. And the results will be shown in heightened efficiency on the part of the teacher and greater progress on the part of the pupil.

Albert Gehring,
Author of ‹The Appreciation of Music,› etc.

PIANOLAS. See Pianoforte.

PIARISTS, members of a religious order, known as «Patres Piarum Scholarum,» and devoted especially to the education of the young. The order was founded in 1597 by a Spanish nobleman, Joseph Calasanza (Saint Joseph Calasanctius) (1556–1648). In 1621 the order was approved of by Gregory XV, and endowed by Innocent XII with all the privileges of a mendicant order (1690). Much of the work of the Piarists was accomplished in Poland and Austria, where there are still flourishing several Piarist schools. The members of the order number some 2,000 and they manage about 200 educational establishments. (See Orders, Religious). Consult Heimbucher, M., ‹Die Orden und Kongregationen der Katholischen Kirche› (Paderborn 1907); ‹Ordinis Clericorum Regularium Pauperum Matris Dei Scholarum Piarum Catalogus Generalis› (Rome 1909); Seyffert, E. J. A., ‹Ordensregeln der Piaristen› (2 vols., Halle 1783).

PIATT, pī'ạt, **Donn,** American lawyer and journalist: b. Cincinnati, Ohio, 29 June 1819; d. Cleveland, Ohio, 12 Nov. 1891. He was educated at the Athenæum, now Saint Xavier's College, Cincinnati, and by private tutors. Though he studied law with his father for a number of years and became a partner in his older brother's law firm, he devoted much of his time during these years to writing for newspapers. In 1852 he was appointed judge of the Court of Common Pleas of Hamilton County, Ohio. On account of the failing health of his wife — he had married in 1847 — he went to France in the summer of 1853 and settled in Paris, from which city he did considerable writing for American and English newspapers on current events. In April 1854 he was appointed secretary of legation at Paris by President Pierce, acting as chargé-d'affaires whenever his chief was absent or ill and acquitting himself in this responsible position with great credit. In 1855 he returned to the United States and again took up his former interests, politics and journalism. He was an active supporter of Lincoln and Fremont. On the outbreak of the Civil War he entered the Union army as a private, attained the rank of colonel and was assistant adjutant-general and chief of staff of General Schenck. He resigned in 1864, and in the fall of 1865 was elected as a Republican member of the Ohio house of representatives. In 1868 he accepted the position of Washington correspondent of the Cincinnati *Commercial*. In March 1871 he founded and began to edit the Washington *Capital*. In 1880 he decided to retire to his old home in Ohio, Mac-o-chee, about 100 miles north of Cincinnati. He did not dispose of his financial interest in the *Capital*, however, until 1890. During the years of his retirement he devoted himself to literature and farming. He wrote ‘The Memoirs of the Men Who Saved the Union’ (Chicago 1887); ‘The Lone Grave of the Shenandoah and Other Tales’ (Chicago 1888); ‘Poems and Plays’ (Cincinnati 1893); ‘Sunday Meditations’ (Cincinnati n. d.); with H. V. Boynton, ‘General George H. Thomas’ (Cincinnati 1893). Consult Miller, C. G., ‘Donn Piatt: His Work and His Ways’ (Cincinnati 1893).

PIATT, John James, American poet: b. James' Mill, Dearborn County, Ind., 1 March 1835; d. Cincinnati, Ohio, 16 Feb. 1917. He was educated at Capitol University (Columbus, Ohio) and Kenyon College (Gambier, Ohio), was clerk in the United States Treasury Department in 1861–67, librarian of the United States House of Representatives 1871–75, consul at Cork, Ireland, in 1882–93 and consul at Dublin April–September 1893. In 1868–69 he was editorially connected with the Cincinnati *Chronicle* and in 1869–78 with the Cincinnati *Commercial*. He attained considerable recognition among American minor poets. His works include ‘Poems by Two Friends’ (1860), with W. D. Howells; ‘The Nests at Washington’ (New York 1864), and ‘The Children Out-of-Doors: A Book of Verses by Two in One House’ (Cincinnati 1885), with S. M. B. Piatt (q.v.); ‘Poems in Sunshine and Firelight’ (Cincinnati 1866); ‘Western Windows and Other Poems’ (New York 1869); ‘The Pioneer's Chimney, etc.’ (Cincinnati 1871); ‘Landmarks, The Lost Farm and Other Poems’ (New York 1872); ‘Poems of House and Home’ (Boston 1879); ‘Penciled Fly-Leaves’ (Cincinnati 1880); ‘At the Holy Well’ (Dublin 1887); ‘Idyls and Lyrics of the Ohio Valley’ (Boston 1888); ‘A Book of Gold’ (1889); ‘The Lost Hunting Ground, etc.’ (London 1893); ‘Little New-World Idyls’ (New York 1893); ‘The Ghost's Entry and Other Poems’ (1895); ‘A Return to Paradise.’ He has also edited: ‘The Poems of George D. Prentice’ (Cincinnati 1876); ‘The Union of American Poetry and Art’ (Cincinnati 1880); ‘The Hesperian Tree, An Annual of the Ohio Valley’ (Cincinnati 1900–03). Consult Howells, W. D., ‘John James Piatt’ (in *Harper's Magazine*, Vol. CXXXV, p. 291, New York 1917).

PIATT, Sarah Morgan Bryan, American poet: b. Lexington, Ky., 11 Aug. 1836. She was graduated from Henry Female College, New Castle, Ky., and was married in 1861 to J. J. Piatt (q.v.). Her first poems were published in the Louisville, Ky., *Journal*. She spent many years in Ireland, where her husband acted as United States consul at Cork and Dublin, with whom she published ‘The Nests at Washington and Other Poems’ (New York 1864): and ‘The Children Out-of-Doors’ (Cincinnati 1885). Her other works include ‘A Woman's Poems’ (Boston 1871); ‘That New World and Other Poems’ (Boston 1876); ‘Poems, in Company with Children’ (Boston 1877); ‘Dramatic Persons and Moods, with Other Poems’ (Boston 1880); ‘An Irish Garland’ (Boston 1885); ‘Selected Poems’ (Boston 1885); ‘In Primrose Time: A New Irish Garland’ (Boston 1886); ‘A Voyage to the Fortunate Isles and Other Poems’ (Boston 1886); ‘Child's World Ballads’ (Cincinnati 1887); ‘The Witch in the Glass’ (1889); ‘An Irish Wild Flower, etc.’ (New York 1891); ‘An Enchanted Castle’ (New York 1893); ‘Completed Poems’ (2 vols., New York 1894); ‘Child's World Ballads, Second Series’ (Cincinnati 1895).

PIAUHY, pē-ow-ē′, or **PIAUHI,** a state of southern Brazil, bounded on the north by the Atlantic (for only 43 miles), on the east by Ceará and Pernambuco, on the south by Bahia and on the west by Maranhão, the boundary being the Parnahyba River, into which all the streams of the state flow. The only one of any importance is the Piauhy, which gives its name to the state, rises in a range also called Piauhy, about 350 miles from its junction with the Parnahyba, and is scarcely ever navigable because of the scant rains. The state has mountain ranges on its eastern and southeastern borders, and river-pierced plateaus elsewhere. The area is officially given as 232,712 sq. km., or about 90,000 square miles. The climate is unhealthy; the rainy season often lasts only a few weeks and occasionally, as in 1877 and 1880, does not come at all. Then famine and typhus follow. The capital city is Therezina, about 220 miles inland on the Parnahyba River, with about 30,000 inhabitants, and some trade in cotton and cattle. Therezina is connected with Amarraçao, the only port of the state on the Atlantic Ocean, by a steamship line. Another line runs from Therezina to the upper limit of navigation on the Rio Parnahyba, Floriano. Various railways have been planned but so far only about 75 miles of the line Therezina — Saint Luis (in Maranhão) have been completed. This line is called the Caxias and Therezina Railway. The population of the state is scanty and includes some independent Indian tribes in the southwestern part; it is estimated at 425,000. The principal crops of the state are cotton, tobacco, maniçoba, rubber, sugar and cereals. More important is the raising of cattle and goats. There are also extensive forests. The mineral wealth is known to be considerable, but is practically undeveloped. Consult Buley, E. C., ‘North Brazil’ (New York 1914); Domville-Fife, C. W., ‘The United States of Brazil’ (New York 1911); ‘The South American Yearbook’ (London 1915).

PIAZZA, *in architecture,* a portico, or covered walk, supported by arches. It properly signifies a square, or open place of any shape, in a city, and has derived its architectural meaning from the fact that in warm countries such open places are in very many instances surrounded by covered walks. Consult Matthews, A., ‘Piazza’ (in *Nation,* Vol. LXVIII, p. 416, New York 1899).

PIAZZI, Giuseppe, joo-sĕp′pĕ pē-ät′sē, Italian astronomer: b. Ponte, Valtellina, Italy, 16 July 1746; d. Naples, Italy, 22 July 1826. He was educated in Milan, Turin and Rome, and appointed professor of mathematics at the University of Malta in 1770, where he remained until its abolition in 1780. In the same year he accepted the chair of mathematics at Palermo, where, through his efforts, an observatory was established in 1789. Previous to its opening he made a journey to England where he established friendly relations with the English astronomers Maskelyne, Herschel, Vince and Ramsden. At his new observatory he made important investigations, the results of which were published in 1792, and in 1801 he discovered the first of the planetoids known to science, which he named Ceres. Though it was visible for but a short time his observations were sufficient to compute its orbit so that it was found in the following year. In 1803 he completed his first catalogue of the fixed stars, which contained 6,784 stars, and received a prize from the Institute of France at Paris, to which it was dedicated. His second catalogue containing 7,646 was completed in 1814 and also received recognition from the Institute at Paris. This catalogue has been of great and lasting value and Piazzi's observations are now being used in a new computation by modern methods. He also made valuable discoveries concerning comets, and in 1817 was appointed chief director of the government observatory at Naples. His most important work after his catalogue was ‘Lezioni elementarii di Astronomia’ (2 vols., Palermo 1817). The Kaiserlich-Königliche Sternwarte, Vienna, has published in its ‘Annalen’ (2 series, Vols. IV–XII, Vienna 1841–51) a collection of his observations under the title ‘Piazzis Beobachtungen, 1792–1813.’ Consult *Edinburgh Journal of Science* (Vol. VI, p. 193, Edinburgh 1827), containing a list of his works; Grant, R., ‘History of Physical Astronomy’ (London 1852); Maineri, B. E., ‘L'Astronomo G. Piazzi’ (Milan 1871).

PICA, a genus of the Crow family; the magpie (q.v.).

PICA, the former name of a size of printing type now known as 12-point. It was used as a base or standard for all type measurement. Six picas square equaled one square inch. It was the double of nonpareil, which is now called 6-point. See also Printing. Consult De Vinne, T. L., ‘Plain Printing Types’ (New York 1900); Legros, L. A., and Grant, J. C., ‘Typographical Printing-Surfaces’ (London 1916).

PICA, a perverted or morbid appetite for substances unfit for food, or incapable of digestion. It is most common in chlorosis and in pregnant and hysterical women. Some insane persons and idiots are subject to it, introducing into the stomach such articles as string, paper and cocoanut fibre. The perverted appetite causes persons having it to eat, with apparent relish, chalk, slate-pencils, coal, plaster, earth, clay pipes, stones, and even filth. Dirt and clay eating (geophagia) exists not only among savages, but also in certain sections of the civilized world, mainly among the lower classes, although sometimes educated people indulge in it. In the case of an appetite for articles of a repulsive nature the disease is called coprophagy, or dung-eating. Physicians incline to regard the vitiated tendency of the appetite as a neurosis connected with the digestive system. It may in some instances be the outcome of habit resulting from the silly desire for notoriety; it may depend on a disordered condition of the brain; may be caused by bad and insufficient diet and chloroanæmia; by inflammation of the mesentery or "the presence in the duodenum of numerous nematoid parasites." It has been supposed that some of the substances eaten supply a deficiency in some of the ingredients of the ordinary food. Horned cattle and sheep are also subject to pica. Prolonged eating of dirt, clay and other unusual substances usually produces emaciation, a protuberant abdomen and a sallow complexion. Sometimes there are serous effusions and hypertrophied liver and spleen. The treatment consists in removal of the causes and the substitution of proper diet. See Bulimia.

PICARD, George Henry, American novelist: b. Berea, Ohio, 3 Aug. 1850. He was graduated from Baldwin University, Berea, in 1869, and from the Cincinnati Medical College in 1877. He has published ‘A Matter of Taste’ (1887); ‘A Mission Flower’ (1887); ‘Old Boniface’ (1881); ‘Madame Noel’ (1900); ‘The Bishop's Niece’ (1902). He is also managing editor of the McClure Newspaper Syndicate.

PICARD, Jean, zhŏṅ pē-kär, French astronomer: b. La Flèche, 21 July 1620; d. Paris, 12 July 1682. He took orders and became prior of Rillé in Anjou. He aided Gassendi in the observation of the solar eclipse of 25 Aug. 1645, and in 1655 succeeded to Gassendi's chair in the Collège de France. In 1666 he became one of the original members of the Academy of Sciences. He was the first to apply the telescope to the measurement of angles; improved instruments and methods; founded the *Connaissance des Temps*, an astronomical annual; and by his efforts secured the establishment of the University of Paris. But his principal achievement was the first exact measurement of a degree of the meridian, made in 1669–71 between Amiens and Malvoisine. In 1671 he made a voyage to the island of Uranienburg in connection with the astronomical observations of Tycho-Brahé. On 11 Jan. 1672 Oldenburg read before the Royal Society of London a letter from Paris describing Picard's method and the length of a degree as determined by him. It is probable that it was Newton's knowledge of this measurement that led him to regard his original conjecture of gravitation as satisfactorily established. (See Newton, Sir Isaac). The following of his works have been published separately: ‘Degrè du Meridien, entre Paris et Amiens, etc.’ (Paris 1740); ‘Measure de la Terre’ (Paris 1740); ‘Traité de Nivellement, etc.’ (Paris 1780). Others of his writings have been published in ‘Memoires de l'Académie des Sciences, Institute de France.’

PICARD, Louis Benoit, loo-ē bĕ-nwä̃, French dramatist: b. Paris, 29 July 1769; d. there, 31 Dec. 1828. He went on the stage and began writing for it at the age of 18, and had his first play, ‘Le Bandinage Dangereux,’ a comedy, accepted in 1789. In 1791 his play ‘Encore des Ménechmes’ gained for him reputation as a playwright. During the Revolution he acted in several of his plays. In 1800 he became director of the Louvois Theatre. In 1807 he was elected a member of the French Academy. In the same year he was appointed director of the Opera, but gave up this position in 1816 to become director of the Odéon where he continued until 1821. Though not a dramatist of the first class, his plays, comedies in prose and verse, exhibit many pleasing characteristics. His style was easy, his power of invention considerable, his humor unforced, his dialogue very natural. He was a prolific writer, producing 94 comedies and seven novels. In some of the former he was assisted by collaborators. His novels were of small importance and added little, if anything, to his literary reputation. Among his best plays are Médiocre et Rampant' (1797); 'La Petite Ville' (1801); 'Les Marionettes' (1807); 'L'Intriguant Maladroit' (1820). Part of his works were published in 1812. A full collection of them was published as 'Œuvres de Picard' in 10 volumes (Paris 1821). Various selections have been issued: 'Œuvres Choisies' (New York 1830); 'Théâtre de Picard' (2 vols., Paris 1877); 'Théâtre Choisi de L. B. Picard' (Paris 1881). Many of his plays have been translated into various foreign languages. Only two, however, have been translated in English: 'The Parasite, or the Art to Make One's Fortune' (Philadelphia 1872); 'The Rebound' (trans. by B. H. Clark, New York 1915). Two of his plays — 'Encore des Ménechines' and 'Médiocre et Rampant' — have been translated into German by Schiller, and from his German into English as 'The Nephew as Uncle' (by G. G. Harris, Leipzig 1856; by T. C. Wilkinson, Ipswich 1882); and 'The Parasite, or, the Art to Make One's Fortune' (by F. S. Nysson, Leipzig and New York 1856; by J. S. S. Rothwell, Munich 1859). Of his novels only one has been translated into English as 'The Gil Blas of the Revolution, or, the Confessions of Lawrence Giffard' (3 vols., London 1825). Consult Dawson, J. C., 'La Petite Ville' (New York 1913); Lenient, Ch., 'La Comédie en France au XVIIIe siècle' (2 vols., Paris 1888); 'La Comédie en France au XIXe siècle' (2 vols., Paris 1898).

PICARD, a modification of Beghard; see Béguines; Religious Sects.

PICARDY, France, an ancient province, now included in the department of the Somme and parts of the Pas-de-Calais, Oise and the Aisne. Amiens was the capital of the province. In 1435 Picardy was joined to Burgundy and in 1477 became a part of France. In the Great War of 1914–18 it was the scene of much of the fighting on the western front. The struggle initiated with the great offensive of the Germans on 21 March 1918 is known as the battle of Picardy.

PICARIÆ, a group of families of birds, variously limited by ornithological systematists. In its later significance, as established by Nitsch (1820) and substantially adopted by Sclater and the more recent writers, it included the rollers, hoopers, kingfishers, cuckoos, parrots, trogons, woodpeckers, nightjars, owls, swifts, humming-birds and their immediate allies, which consequently are known as «picarian» birds. The still more modern group *Coraciiformes* nearly conforms with it but omits the parrots and cuckoos. The group embraces more than 1,800 species, mainly tropical — most of the families being exclusively so. The group is fully discussed by Stejneger, 'Standard Natural History' (Vol. IV, 1885), and by Evans, 'Cambridge Natural History' (Vol. IX, 1900).

PICASSO, pē-käs'sō, **Pablo,** Spanish painter and sculptor: b. Malaga, 1881. Picasso is of the post-impressionist school and is famed as the founder of cubism. While eminent as a technician he has ever sought the psychical in form rather than the physical and regards color only as to its light effects. His paintings and sculptures were exhibited at the Grafton Galleries, London, in 1912, and at the International Exhibition of Modern Art in New York in 1913. Consult Huneker, J. G., 'The Pathos of Distance' (New York 1913).

PICAYUNE, pĭk-ą-yoon', a name derived from the Carib language and used in Louisiana for a small coin worth six and one-quarter cents, current in the United States before 1857 and known in different States by various names (fourpence, fippence, fip, sixpence, etc.). The word picayune has long been used, especially in the Southern States, in a slang sense to indicate a person or thing of slight value or small importance.

PICCADILLY, pĭk'ą-dĭl-ĭ, in London, a famous street extending for a mile between the Haymarket and Hyde Park corner. At its northern end is an open space known as Piccadilly Circus. Its western half is flanked on the south by the Green Park. In one part of Piccadilly are many fashionable residences and clubs, while another portion contains many handsome shops and stores. Many articles of wearing apparel have been named after Picadilly, from having been first offered for sale by haberdashers in this thoroughfare. Indeed, it is claimed that the very name of the street has a connection with this trade, though its origin is not absolutely established. About 1623 there was a Pickadilly Hall at the northeast corner of Haymarket and it is surmised that the owner of it had acquired his fortune by the sale of pickadillies, by which name the hems or collars worn with the costumes in vogue at the beginning of the 17th century were known. In its long history Piccadilly has seen many changes. In 1902 part of it was considerably widened. In spite of the fact that some of its historical houses have had to give place to improvement at various times, there are still many buildings left which possess great historical interest. Amongst these are Saint James's Church, built by Wren in 1682–84; Burlington House, part of which dates back to 1695, and which now houses the Royal Society and many other scientific bodies as well as the Royal Academy of Arts; Devonshire House; Apsley House, the residence of the Duke of Wellington. At 139 Piccadilly Lord Byron passed part of his married life and his only daughter was born there. Of more modern houses there are the Museum of Geology; Piccadilly Hotel; Royal Institute of Painters in Water Color; Prince's Restaurant; the Albany Chambers, long residence of many famous English writers; the Burlington Arcade, the home of many fashionable shops. Among the clubs located in Piccadilly are the Naval and Military, formerly the house of Lord Palmerstone, Junior Naval and Military, Badminton, Saint James's, Savile, Junior Athenæum, Cavalry and Lyceum. Consult Baker, H. B., 'Stories of the Streets of London' (London 1899); Besant, Sir Walter, 'London of the 18th Century' (London 1902); 'London of the 19th Century' (London 1909); 'North of the Thames' (London 1911); Clinch, G., 'Mayfair and Belgravia' (London 1892); Hatton, E., 'A New View of London' (London 1708); Harrison, Walter, 'A New and Universal History, Description and Survey of the Cities of

London and Westminster, Etc.' (London 1776); Hunt, J. H. Leigh, 'The Town, Etc.' (London 1848); Hutchings, W. W., 'London Town, Past and Present' (London 1909); Hutton, Laurance, 'Literary Landmarks of London' (London 1897); Jesse, J. H., 'Literary and Historical Memorials of London' (Vol. I, London 1847); Lambert, B., 'The History and Survey of London' (4 vols., London 1806); Lang, Andrew, 'Piccadilly' (in *Scribner's Magazine,* Vol. X, p. 135, New York 1891); Lang, E. M., 'Literary London' (London 1906); Lemon, M., 'Up and Down the London Streets' (London 1867); Loftie, W. J., 'London City: Its History, Streets, Traffic' (London 1891); 'New and Compleat Survey of London' (2 vols., London 1742); Skinner, R., 'A New and Complete History and Description of the Cities of London, Westminster, Etc.' (London 1796); Smith, J. F., 'An Antiquarian Ramble in the Streets of London, Etc.' (2 vols., London 1846); Stopes, C. C., 'Early Piccadilly' (in *Athenæum,* p. 125, London, July 1901); Taylor, G. R. S., 'An Historical Guide to London' (London 1911); Weir, W., 'Piccadilly' (in 'London,' ed. by Chas. Knight, Vol. I, p. 297, London 1841); Welch, C., 'Modern History of the City of London' (London 1896); Wheatley, H. B., 'London, Past and Present' (Vol. III, London 1891); 'Round About Piccadilly and Pall Mall' (London 1870).

PICCINNI, pēt-chē'nē, **Niccolo,** Italian musical composer: b. Bari, Italy, 16 Jan. 1728; d. Passy, near Paris, France, 7 May 1800. He studied at the Conservatory of San Onofrio at Naples and began to compose comic and serious operas, chiefly for the stages of Rome and Naples, with such success that for many years he was without a rival in Italy. In 1776 he accepted an invitation from the French court and went to Paris. There he brought out the 'Roland of Quinault' (1778), which, notwithstanding the opposition of Gluck (q.v.) and his friends, was successful. Although Gluck and Piccinni were personally reconciled, yet the war between their respective admirers continued and in order to compare their merits, the two rivals composed the same subject, 'Iphigenia in Tauris'; in this contest Gluck had the advantage. Piccinni was appointed teacher of vocal music in the Royal Singing School in 1784, but the Revolution deprived him of his appointments and he returned to Naples. At first he was well received by the king, who granted him a pension. But before long he was, though without cause, suspected to hold revolutionary views. He was deprived of his pension and finally, though not actually sent to jail, restrained under arrest at his own house. In 1798, however, friends succeeded in gaining him permission to return to Paris. Though he was received there with much kindness and was granted a small pension, the irregular payment of the latter caused him frequent and serious financial embarrassment. His health, too, failed and he died in his 73d year as the result of a stroke of paralysis at Passy where he had gone in the hope to recover his health. His great success is now difficult to understand. He was very conservative, possessed little originality, but withal was an accomplished and scholarly composer of pleasing music, which was always quite correct. He was a very prolific worker and in the period of 40 years, from 1754–94, he composed 139 operatic works. His native town has honored his memory by erecting a statue in one of its most prominent streets. Consult Cametti, A., 'Saggio Cronologico (1754–94) delle Opere Teatrali di Niccolò Piccinni' (in 'Rivista Musicale Italiana,' Vol. VIII, pp. 75–100); Ginguené, P. L., 'Notice sur la Vie et les ouvrages de N. Piccinni' (Paris 1800); Le Brisoys Desnoiresterres, G., 'La Musique Française au XVIIIe siècle. Gluck et Piccinni. 1774–1800' (Paris 1872); Longo, A., 'Gluck e Piccinni' (in 'Soc. Reale di Napoli. Reale Accad. di Archeologia, Letters e Belle Arti,' N. S., Vol. V, pp. 311–332, Naples 1917); Thoinau, E., 'Notes Bibliographiques sur la Guerre Musicale des Gluckistes et des Piccinnistes' (Paris 1878).

PICCIOLA, pēt'chō-lä («poor little one»), a story by Saintine (Joseph Xavier Boniface), a French author, born in Paris, 10 July 1798, and who died there, 21 Jan. 1865. It was published in 1836, ran through numerous editions, was translated into many languages and received from the Academy the Montyon prize. The tale is a simple and touching recital of the loving care bestowed by a prisoner of Napoleon's time upon a plant growing between the stones of his cell and from his tender naming of which the sketch takes its title. An infusion of it restores him from dangerous illness and when he is released and leaves, the plant droops and dies.

PICCOLO, a small flute having the same compass as the ordinary orchestral flute, but producing sounds one octave higher than the notes as they are written; it is also called the octave flute. Piccolo is also the name of an organ stop of two feet length giving a piccolo tone.

PICCOLOMINI, pĭk-kō-lŏm'ē-nē, Italian family of Sienna. The two most celebrated members are: 1. ÆNEAS SYLVIUS BARTHOLOMÆUS, afterward Pope Pius II. (See PIUS II). 2. OCTAVIO, grand-nephew of the first: b. Amalfi, 1599; d. Vienna, 10 Aug. 1656. He served in the armies of the German emperor and became one of the distinguished generals in the Thirty Years' War. He was a favorite of Wallenstein, who entrusted him with a knowledge of his projects, when he purposed to attack the emperor. Nevertheless he made himself the chief instrument of Wallenstein's overthrow, and after the latter's assassination (1634) was rewarded with a portion of his estates. After the battle of Nördlingen (1634), in which the Swedes were greatly weakened, he advanced with Isolani through Würtemberg, over the Main. In the following year he was sent to aid the king of Spain against the French and delivered the Netherlands from the hands of the latter. His further successful campaigns in the Thirty Years' War induced Philip IV of Spain to beg the emperor to allow him to lead the Spanish armies. The request was granted and as a Spanish general Piccolomini again distinguished himself in the Netherlands, against both the French and the Dutch. The king of Spain rewarded him for his services with the duchy of Amalfi. During the victorious advance of the Swedes in 1648 he was recalled by the emperor and appointed, with the title of field-marshal, to the command of the troops destined to oppose them. His military career was concluded after a short campaign in the same year by the Peace of Westphalia. He is one of the principal characters in Schiller's trilogy of 'Wallenstein,' to the second part of which he gives the title. Consult Weyhe-Eimke, 'Ottavio Piccolomini' (1871).

PICE, pīs, a small East Indian coin, value one-fourth of an anna or about three-quarters of a cent.

PICHEGRU, Charles, shärl pēsh-grü, French general: b. Arbois, department of Jura, 16 Feb. 1761; d. Paris, April 1804. He was for some time a tutor at the College of Brienne, but soon exchanged this profession for that of a soldier and served with a French artillery regiment. He was chosen the commander of a body of volunteers from Besançon to join the Army of the Rhine. He was rapidly advanced, and in October 1793 was appointed general-in-chief of the same army. In 1794 he was selected as the fittest man to command the Army of the North, then beaten and demoralized. He defeated the enemy at Courtrai, Menin, Hoogelede, reduced to subjection Bruges, Ghent, Antwerp, Hertogenbosch, Venloo and Nijmegen, crossed the Maas and the Waal on the ice in the winter of 1794–95, subjugated Holland and entered Amsterdam in January 1795. Then he returned to Paris to enjoy his triumph. He was now at the height of his fame and was honored by the Convention with the title of savior of his country. Soon after he set out to take the command of the army of the Rhine and Moselle, but in this post displayed none of his former energy, and entering into negotiations with the Bourbons was deprived of his command under suspicion of treason (1796). Having secured his election to the Council of Five Hundred, he was chosen its president (March 1797) and became the soul of the party hostile to the Revolution. He was proscribed and transported to Cayenne, but managed to make his escape the year following. In 1803 he was in London, and there he allied himself with George Cadoudal in a conspiracy to assassinate Napoleon. Having gone to Paris for the purpose, he was captured by the police (1804) and committed to the Temple prison, where he was found strangled 5 April. Consult the 'Life' by Bouziers (1870); also Daudet, 'La Conjuration de Pichegru' (1901).

PICHICIAGO, or **PICHY-CIEGO**. See Armadillo.

PICHINCHA, pē-chēn'chä, (1) a volcano in Ecuador in the western Cordillera right on the equator northwest of the city of Quito, which it destroyed in 1660 by an eruption. Since then it has been dormant. The mountain has five peaks, the highest measuring 15,918 feet above the sea; the crater is nearly a mile across and is 2,500 feet deep — one of the deepest in the world. (2) A province of Ecuador, including the plateau of Quito and the Andean slopes, named from the volcano. Pichincha is said to signify "boiling mountain." The province is watered by the Perucho, which empties into the Pacific, and by the head-waters of the Napo. Area, 8,300 square miles; pop. (est) 215,000. Principal products, sugar, maize, indigo, cotton and fruit. Capital, Quito.

PICHON, pē-shôn, **Stéphen (Jean Marie)**, French statesman: b. Arnay-le-Duc, 10 Aug. 1857. He received his education at the University of Paris, studied medicine, but soon abandoned it for journalism. In 1880 he became a member of the staff of *La Justice*, a journal owned by Georges Clemenceau. In 1882 Mr. Pichon became a member of the municipal council of Paris, and was several times its secretary. He became a member of the Chamber of Deputies in 1885 and was secretary of the Chamber in 1889–90. In 1894 he was appointed Minister to Haiti, and subsequently served as Minister to Brazil, China and Tunis. In 1905 he was elected senator and in 1906 Clemenceau appointed him Minister of Foreign Affairs. He held the same portfolio in the cabinets of Briand 1910–11 and of Barthou in 1913. On the formation of Clemenceau's War Cabinet, on 16 Nov. 1917, Mr. Pichon again became Minister of Foreign Affairs and also became a member of the War Committee of the Cabinet. He was one of the French delegates to the Peace Conference.

PICHURIC ACID. See Lauric Acid.

PICIDÆ, pĭs'ĭ-dē, the family name of the woodpeckers (q.v.); the typical sub-family is *Picinæ;* and the typical genus *Picus*.

PICK, Bernhard, American Lutheran clergyman: b. Kempen, Prussia, 19 Dec. 1842. He studied in Berlin and was graduated from the Union Theological Seminary in New York in 1868. He was ordained in the Presbyterian ministry in that year, and held various important charges, but in 1884 joined the Lutheran denomination, in which he has since officiated. He is a learned Hebrew and rabbinical scholar, a contributor to McClintock and Strong's Schaff-Herzog and the Jewish encyclopædias; has made numerous translations, and is author of 'Luther as a Hymnist' (1875); Historical Sketch of the Jews' (1887); 'The Talmud: what it is and what it says about Jesus and the Christians' (1887); 'The Extra-Canonical Life of Christ' (1903); 'Hymns and Poetry of the Eastern Church' (1908); 'Remains of Gospels and Sayings of Christ' (1908); 'Apocryphal Acts of Paul, Peter, John, Andrew and Thomas' (1909); 'Translations of the Bible' (1913); 'The Cabala' (1913); 'Jesus in the Talmud' (1913). He is a member of the German Oriental Society, Leipzig.

PICKARD, Samuel Thomas, American journalist and biographer: b. Rowley, Mass., 1828; d. 1915. Mr. Pickard acquired the *Transcript* of Portland, Me., in 1852 and continued its editor until 1894. He married a niece of John Greenleaf Whittier, by whom he was made his literary executor. Pickard was also appointed trustee of the Whittier homestead and birthplace. His published works include 'Hawthorne's First Diary' (1897); 'Whittier as a Politician' (1901); 'Whittier Land' (1904); 'Life and Letters of John Greenleaf Whittier' (1907) and numerous monographs and literary articles in newspapers and reviews.

PICKENS, pĭk'ĕnz, **Andrew**, American soldier: b. Paxton, Pa., 19 Sept. 1739; d. Tomassee, S. C., 17 Aug. 1817. He removed with his parents to the Waxhaw Settlement, S. C., in 1752, was engaged in the Cherokee War of 1761, and at the outbreak of the American Revolution was appointed a captain of militia, from which rank he rose to be brigadier-general. He defeated General Boyd at Kettle Creek in 1779, was engaged in the battle of Stone Ferry in the same year, routed the Cherokees at Tomassee, and in 1781 so distinguished himself at the battle of Cowpens that Congress voted him a sword. He compelled the surrender of the British forts at Augusta, Ga., fought under General Greene in the campaign of Ninety-six, and by a successful expedition against the Cherokees in 1782 gained from them a large strip of territory which later became a part of Georgia. In 1783–94 he was a member of the South Carolina legislature, and in 1793–95 served in Congress. He was a member of the State Constitutional Convention, a commissioner in many important treaties with the Indians, and was again member of the legislature in 1801 and 1812.

PICKENS, Francis Wilkinson, American legislator and diplomat: b. Togadoo, S. C., 7 April 1805; d. Edgefield, S. C., 25 Jan. 1869. He was educated at the South Carolina College, admitted to the bar in 1829 and in 1832 elected to the State legislature. He was a member of the Nullification Party and an advocate of extreme State rights. In 1834–44 he was a member of Congress, from 1858–60 was United States Minister to Russia, and in the latter year was elected governor of South Carolina. He was prominent in the secession movement, demanded the surrender of Fort Sumter and erected the batteries which caused the reduction of that fort. He retired from public life in 1862.

PICKENS, Fort. See FORT PICKENS.

PICK'EREL, a small pike (q.v.).

PICKEREL-FROG. See FROG.

PICKERING, pik'ėr-ing, **Charles,** American naturalist and physician, grandson of Timothy Pickering (q.v.): b. Starucca Creek, Pa., 10 Nov. 1805; d. Boston, Mass., 17 March 1878. He was graduated from Harvard in 1823, from its medical department in 1826 and established a practice in Philadelphia. In 1838–42 he was naturalist in the United States Exploring Expedition under Lieut. Charles Wilkes. In 1843–45 he traveled through Egypt, Arabia, East Africa and India, engaged in scientific research. He was a prominent member in the leading scientific societies of America and wrote 'The Races of Man and Their Geographical Distribution' (1848); 'Chronological History of Plants; Man's Record of His Own Existence Illustrated Through Names, Uses and Companionship' (1879); etc.

PICKERING, Edward Charles, American astronomer: b. Boston, Mass., 19 July 1846; d. Cambridge, Mass., 3 Feb. 1919. He was graduated from Harvard in 1865, was instructor in mathematics at the Lawrence Scientific School there in 1865–67, accepted the chair of physics at the Massachusetts Institute of Technology in 1867, where he remained until 1877, after which he was professor of astronomy at Harvard and director of the Harvard Observatory. He established the first physical laboratory in the United States; constructed the first telephone receiver in 1870 and published the 'Elements of Physical Manipulation' (1874–76). In Cambridge he made over 1,400,000 measurements of the light of the stars. Under his direction the endowments of the observatory increased seven-fold; 250,000 photographs of the stars were taken; 70 quarto volumes of annals were published and a station was established in Arequipa, Peru, which supplemented the study for stars in all parts of the sky, and where over 240,000 photographs were taken. He was the recipient of numerous academic honors and was a member of various scientific societies all over the world.

PICKERING, John, American linguist and lexicographer, son of Timothy Pickering (q.v.): b. Salem, Mass., 7 Feb. 1777; d. Boston, Mass., 5 May 1846. He was graduated from Harvard in 1796, studied law, was secretary of the legation at Lisbon in 1797 and in 1799 was private secretary to Rufus King, United States Minister to England. He returned to the United States in 1801 and after admission to the bar practised law in Salem until 1827 and then removed to Boston, where he was city solicitor in 1827–46. He served six terms in the Massachusetts legislature, was president of the American Academy of Science and first president of the American Oriental Society. He possessed a wide knowledge of European, Asian, Egyptian and American Indian languages, and published 'Adoption of a Uniform Orthography for the Indian Languages' (1820); 'Vocabulary of Words and Phrases Peculiar to the United States' (1816); 'A Comprehensive Dictionary of the Greek Language' (1826), etc. Consult Pickering, M. O., 'Life of John Pickering' (1887).

PICKERING, Timothy, American statesman; b. Salem, Mass., 17 July 1745; d. there, 29 Jan. 1829. He was graduated at Harvard in 1763, was admitted to the bar, became register of deeds for Salem County and displayed so great interest in military matters that he was commissioned lieutenant of militia in 1766 and became colonel in 1775. He was a prominent and active patriot, drew up the pamphlet called 'State of the Rights of the Colonists' in 1773, and drafted the Salem protest against the Boston Port Bill. In 1775 he wrote 'An Easy Plan of Discipline for the Militia,' an able manual much used in Massachusetts and for the whole Continental army; and in December 1776 joined the Revolutionary army, meeting Washington in February 1777 and becoming adjutant-general. He fought at Brandywine and Germantown, was quartermaster-general, general 1780–85, and was present at Yorktown. At the close of the war he settled in the Wyoming Valley, where he organized Luzerne County. Pickering concluded a treaty with the Six Nations in 1791, was appointed Postmaster-General in that year and Secretary of War in 1795, founded the United States Military Academy at West Point, and did much for the upbuilding of the navy. He was Secretary of State from December 1795 to May 1800, and after his retirement lived in some destitution on his property in Pennsylvania, whence he returned to Massachusetts. In 1803 he was elected United States senator and in that capacity as in his office of Secretary of State roused popular hatred by his extreme Federalist position. From 1812 to 1814 he was again out of public life, but was elected to Congress in the latter year and to the Massachusetts Executive Council in 1817. In the second war with England he was a leader of the New England opposition and favored the Hartford Convention (q.v.). Consult the biography by Octavius Pickering, his son, and C. W. Upham (1867–73).

PICKERING, William, English publisher: b. 1796; d. Turnham Green, Middlesex, 27 April 1854. He was apprenticed to a bookseller at 14; was himself bookseller 1820–23; and in 1821 began to publish the famous Diamond Classics in 48mo. Of these there were 24 volumes,, including Shakespeare's Works, Walton's ‘Lives’ and ‘Angler,’ Milton's ‘Paradise Lost,’ the Greek Testament and Homer (in the first diamond Greek type), Horace, Virgil, Catullus, Dante, Tasso and Petrarch, all being printed by Charles Corrall. His other notable reprints were the ‘Book of Common Prayer’ (1844), Aldine edition of the English poets, etc. He was publisher to Coleridge, Alexander Dyce, Sir Harris Nicolas and others. Pickering introduced the use of cloth covers instead of paper boards, about 1825. He used the Aldine emblem with the motto «Aldi Discip. Anglvs,» as well as other emblems. He was financially ruined by standing security for a friend, and died in want.

PICKERING, William Henry, American astronomer: b. Boston, 15 Feb. 1858. He received his education at the Massachusetts Institute of Technology, where he became an instructor. Later he was appointed assistant professor at the Harvard Observatory. He led expeditions to observe the total solar eclipses of 1878 in Colorado, of 1886 in Grenada, British West Indies, of 1889 in California, 1893 in Chile and 1900 in Georgia. In 1890 he established the Southern Station of the Harvard Observatory at Arequipa, Peru, and erected the first telescope and dome for the Lowell Observatory in 1894 at Flagstaff, Ariz. He also established a temporary observatory at Mandeville, Jamaica, British West Indies (1900), and a permanent one there in 1911. While there he devoted his studies to the moon and Mars, indicating that both snow and vegetation are to be found on the former. Monthly reports are issued regarding the latter. He has also made some notable mountain ascents, and has published ‘Walking Guide to Mount Washington Range’ (1882); ‘Investigations in Astronomical Photography’ (1895); ‘Visual Observations of the Moon and Planets’ (1900); ‘An Atlas of the Moon’ (1903); ‘The Moon’ (1903); ‘Lunar and Hawaiian Physical Features Compared’ (1906); ‘Researches of the Boyden Department’ (1908); four volumes of ‘Annals of the Harvard College Observatory,’ and over 200 articles in astronomical magazines. He is a member of various distinguished scientific societies.

PICKET, a wooden stake with a sharpened end, or sharpened at both ends, used variously; in the war of 1861–65 often employed to hinder the advance of cavalry. The United States cavalry use a picket-pin, or short iron rod, which is thrust into the ground to hold a picket line or tether, to which the horses are attached for grazing. Also a guard posted in front of an army to give notice of the approach of an enemy; an outlying picket. Also one of a company of striking workmen chosen to watch the place of their late employment and discourage other workmen from accepting employment there.

PICKETING, the practice of placing pickets or strikers on watch over the premises of a factory or other place of employment where there is a strike. See STRIKE.

PICKETT, pĭk'ĕt, **George Edward**, American military officer: b. Richmond, Va., 25 Jan. 1825; d. Norfolk, Va., 30 July 1875. He was graduated from West Point in 1846, served in the Mexican War, especially distinguishing himself at Contreras, Churubusco and Chapultepec, and was promoted to the rank of brevet captain in 1847. He served later on the frontier in Washington Territory, and in 1856 occupied San Juan Island, where he prevented the landing of British troops and received the thanks of Congress for his services. In 1861 he resigned from the Federal army and joined the Confederate forces, becoming major-general in 1862. At Fredericksburg his division held the centre of Lee's line, and at Gettysburg in 1863 he made the gallant assault of Cemetery Ridge, famous as «Pickett's charge.» (See GETTYSBURG). He later commanded the department of North Carolina, successfully defended Petersburg in 1864 and performed excellent service at Dinwiddie Court House and Five Forks. He engaged in business in Richmond after the war.

PICKING, Henry Forry, American naval officer: b. Somerset County, Pa., January 1840; d. Charlestown, Mass., 8 Sept. 1899. He was graduated from the United States Naval Academy in 1861 and was assigned to the North Atlantic blockading squadron. He participated in the sinking of the Confederate *Petrel*, was engaged in the *Monitor-Merrimac* engagement, served in the East Gulf and the South Atlantic blockading squadrons, was promoted lieutenant in 1862 and in 1865 placed in command of the *Nahant*. After the war he continued in the service, became rear-admiral in 1898 and died while commandant of the navy yard at Charlestown.

PICKLE WORM, or PICKLE MOTH, moth of the Pyralidæ which is numerous in southwestern United States. It bores into cucumbers when they are about half developed and there lives in the larval state. Squash, melon and cantaloupe are also favorite feeding plants for this pest. The sole remedy for its abatement appears to be a thorough spraying with arsenic compounds before the fruit is grown and while the early generation of the pickle worm is feeding on the plant leaves.

PICKLES. Food that has been pickled, especially cucumbers that are preserved in vinegar. They are prepared by first washing in clean water, then soaking for a few days in brine, afterward drying them with a cloth or draining them, and finally putting them into the vessel in which they are intended to be preserved and pouring in boiling vinegar until the vessel is quite full. Before the vinegar is poured in, spices are added. When the vegetables that are to be pickled are naturally soft the vinegar is sometimes poured in cold. To preserve the color of vegetables that are naturally green the best means is to steep vine, cabbage, spinach or parsley in the vinegar. In many cases this is effected with much less trouble by boiling the vinegar in copper vessels, and thus forming an acetate of copper, or by directly adding that salt, which is green; but this practice is a very injurious one, as the acetate of copper is poisonous. The vegetables most often pickled are cabbage, cauliflower, gherkins (young cucumbers), French beans, onions, walnuts, mushrooms and nasturtiums. Chile peppers and sweet peppers, olives and capers are the most common kinds of imported pickles, and mangoes are occasionally used. Meats are also sometimes pickled in brine. A diluted acid solution for cleaning metal castings is termed a pickle or pickling solution.

PICKNELL, pĭk'nĕl, **William Lamb**, American painter: b. Hinesburg, Vt., 30 Oct. 1854; d. Marblehead, Mass., 9 Aug. 1897. He went to Europe in 1874, where he studied with George Innes at Rome, and later at the École des Beaux Arts under Gérôme. He settled at Pont Aven, Brittany, where he worked for five years under Robert Wylie and painted 'Route de Concarneau,' a picture that established his position as an artist, won an honorable mention in the Salon of 1880 and now hangs in the Corcoran Art Gallery. His later life was spent in Annisquam, Mass., and France. He was a landscape painter of poetic qualities, with a feeling for atmospheric effects. Subjects found along the coast chiefly attracted him. His pictures are to be found in the galleries of Boston, New York, Brooklyn, Pittsburgh and the Luxembourg, Paris.

PICKWICK PAPERS. «The Posthumous Papers of the Pickwick Club,» issued in 20 monthly numbers, began to appear the last of March 1836, and were concluded in November 1837. They were the work of a young man but 25 years old, who had hitherto written nothing more than a group of sketches dealing mainly with London life. A firm of London publishers, Messrs. Chapman and Hall, was then projecting a series of «cockney sporting plates» by Robert Seymour, a rather clever artist. There was to be a club, the members of which were to be sent on hunting and fishing expeditions into the country. Their guns were to go off by accident; fishhooks were to get caught in their hats and trousers; and all these and other misadventures were to be depicted in Seymour's comic plates. At this juncture, Charles Dickens was called in to supply the letterpress — that is, the description necessary to explain the plates and connect them into a sort of picture novel such as was then the fashion. Though protesting that he knew nothing of sport, Dickens nevertheless accepted the commission; he consented to the machinery of a club, and in accordance with the original design sketched Mr. Winkle who aims at a sparrow only to miss it. Seymour dying, other artists took his place; but from the very first Dickens was the master. Only in a few instances did he adjust his narrative to plates that had been prepared for him. He himself led the way with an instalment of his story, and the artist was compelled to illustrate what Dickens had already written. The story thus became the prime source of interest, and the illustrations merely of secondary importance. By this reversal of interest, Dickens transformed, at a stroke, a current type of fiction, consisting mostly of pictures, into a novel of contemporary London life. Simple as the process may appear, others who had tried the plan had all failed. Pierce Egan partially succeeded in his 'Tom and Jerry,' a novel in which the pictures and the letterpress are held in even balance. Dickens, his genius working silently and perhaps unconsciously, won a complete triumph.

To begin with, Dickens had no other aim than to amuse the public month by month. There was in his mind no thought of a novel with a plot to be worked out to a logical conclusion. The first number, of which only 400 copies were bound, awakened only moderate interest. But all was changed with the introduction of Sam Weller in the fifth number; and by the time the fifteenth number was reached, the printer was binding 40,000 copies. People of every class and every age bought or borrowed *Pickwick*. «All the boys and girls,» Miss Mitford wrote of Dickens, «talk his fun — the boys in the streets; and yet those who are of the highest taste like it the most.» Doctors read the book while riding from patient to patient, and judges read it while juries were deliberating. The fact is, 'Pickwick' was the most amusing burlesque of London life that had ever been written, and it has not since been equalled. Its author was intimately acquainted with all the scenes and persons that he described. He began with the House of Commons, which he turned into the Pickwick Club, with pompous speeches, noisy debates and apologies from gentlemen who wished their abusive remarks to be understood only in «a Pickwickian sense,» that is, in a Parliamentary sense. Then he passed on to the law and the courts — pettifoggers who take up civil suits «on spec,» to the examination of witnesses, to the judge's charge to the jury and finally to the debtors' prison. All the way along, he drew in careless abandon character after character, running back and forth between the gay and the serious. 'Pickwick' contains more than 150 characters, of whom two stand out conspicuously among Dickens's greatest creations. First there is Pickwick himself, a humorous compound of benevolence and simplicity, shrewdness and common sense, always a gentleman, despite his oddities and follies, with a dash of heroism in the background. And less fantastic, there is Sam Weller — the embodiment of all that is delightful in the London cockney. From the moment he enters the novel until the end, his gaiety pervades the whole up to the climax when he takes the stand for his master in the famous case of Bardell vs. Pickwick, and turns the laughter upon the defendant's counsel Oddly enough, here is a novel which did not set out to be a novel is Dickens's supreme achievement in humor.

Wilbur L. Cross.

PICO, pē'kō, an island of the Azores (q.v.) group; it is 25 miles long with an area of 175 square miles. It is crossed by a volcanic ridge which terminates in the peak, El Pico, 7,613 feet in height. The island is well wooded and fertile; but earth had to be brought from Fayal to cover or enrich the lava. Now the slopes are covered with vegetation, especially vines, and the island exports an excellent wine. The chief town is Villa-di-Laguna. Pop. 15,138.

PICO DELLA MIRANDOLA, Giovanni, jō-văn'nē pē'kō dĕl'lă mē-răn'dō-lă, Count of Mirandola, surnamed the «Phœnix,» Italian humanist: b. Mirandola, 24 Feb. 1463; d. Florence, 17 Nov. 1494. He undertook the course in canon law at Bologna, but repugnance to the study and an inclination to philosophical and scientific subjects led him to visit the different parts of Italy and France for the purpose of observation and to attend the lectures of the most distinguished professors. In 1484 he went to Florence, where he became a member of the Platonist group known as the «Academy.» In 1486 he proposed 900 theses on all subjects, which he declared himself ready to defend, according to the custom of the times, in public. No one ventured to appear against him, and the envious endeavored to implicate him in a charge of heresy. Innocent VIII forbade the reading of the propositions, and Pico withdrew to France. He was absolved, however, from any suspicion of heresy by Alexander VI. Having next applied himself to the study of Biblical literature he published the fruits in 'Heptaplus,' a mystical or cabalistic explanation of the history of the creation, in which he derives Plato's doctrines from Moses. Two years after he publishes a treatise — 'De Ente et Uno' — in which he aimed to unite the opinions of Plato and Aristotle. He was wealthy and gave away most of his property with the intention of becoming an itinerant preacher, but died before carrying out the plan. A collection of his works, almost all in Latin, was published at Venice in 1498. He is introduced as one of the characters in Alfred Austin's drama, 'Savonarola.' Consult Dreydroff, 'Das System des Johannes Pico von Mirandola und Concordia' (1858); Pater, 'Studies in the History of the Renaissance' (1873).

PICO DE TEIDE, pē'kō dā tā'ē-thē. See TENERIFFE, PEAK OF.

PICOLINE, *in chemistry*, a base C_6H_7N, isomeric with aniline and closely related to pyridine, obtained from bone oil, coal-tar, naphtha, etc., the name being derived from Latin, *pix*, pitch, and *oleum*, oil. It is a colorless, mobile, very pungently odorous liquid, with an alkaline reaction and a boiling point of 135° C. One variety is very corrosive, with choking vapors; it quiets the excited nerve centres if used as a hypodermic injection.

PICOT, François, frăñ-swä pē-kō, French painter: b. Paris, 1786; d. there, 15 March 1868. He was a pupil of Vincent and his early reputation was won by his large picture 'Cupid and Psyche'; which was followed by 'Raphael and La Fornarina'; and an 'Evening Landscape.' His 'Death of Sapphira,' also an early work, is in the church of Saint Severin at Paris. The French government purchased for the Luxembourg Gallery his 'Orestes Sleeping in the Arms of Electra.' He painted a 'Madonna' for the church of Loretto at Paris, and in the Louvre executed two ceiling pictures, 'Egypt and Greece,' and the 'Fall of Pompeii and Herculaneum.' His colossal figure of 'Christ' in the church of Saint Vincent de Paul at Paris is in the Byzantine style. He, however, met with much greater success as a teacher of painting than as a painter.

PICOT, Georges, zhŏrzh pē-kō, French historian and jurist: b. Paris, France, 24 Dec. 1838; d. 1909. He studied law, was appointed a judge in the Seine tribunal in 1865, and in 1877 accepted a post in the Ministry of Justice. He was editor of *Le Parlement* and in 1878 succeeded Thiers at the Academy of Moral and Political Sciences, where he became permanent secretary in 1896. Among his publications are 'Recherches sur la Mise en Liberté sans Caution' (1863); 'Histoire des Etats Généraux' (1872); 'La Réforme Judiciare' (1881); 'Décentralisation et ses Différents Aspects' (1897); 'L'Institut de France' (1907), etc.

PICPUS, Society or Congregation of, a religious association founded in Paris, 1805, by Pierre Coudrin, priest. The associates were to devote themselves, as a protest against the prevailing unbelief, to the perpetual adoration of the Blessed Sacrament; they were also to prepare candidates for the priesthood and for service in the foregin missions. The mother house was the conventual building of the original congregation of Picpus, a Franciscan fraternity. They had charge of seminaries in various parts of France. In 1825 they sent six of their priests to the mission in the isles of the Pacific, and those islands have ever since been the field of their missionary labors. They have two houses in the United States, at Olema, Cal., and Fairhaven, Mass.

PICQUART, Georges, zhŏrzh pē-kär, French soldier, prominent in «the Dreyfus case»; b. Strassburg, 6 Sept. 1854; d. 19 Jan. 1914. He entered Saint Cyr in 1872, and, after two years there, spent two more in the Ecole d'Etat-major, from which he was graduated in 1876 with the second rank in his class. From the General Staff School he entered the infantry; became captain in 1880 and major in 1888 upon his return to France from three years in Tonkin; in 1890-93 was professor at the Superior Military School; was promoted lieutenant-colonel in 1896; and in the year before became head of the Department of Information. In May 1896 he obtained possession of a telegram card, the famous *petit bleu*, addressed to Esterhazy, which prompted him to inquire into that officer's record and way of life. The result was that he found Esterhazy's writing was clearly that of the famous bordereau; it was identified as such by Bertillon of the Paris police and by Du Paty de Clam. His investigations were soon interfered with by his superiors; he was disgraced and sent to Tunis 16 Nov. 1896, the Department of Intelligence being entrusted to Colonel Henry, who concealed the truth so far as he could and later committed suicide, when his dishonesty had been disclosed. Picquart apparently had been sent to Tunis in the hope that he would be killed in battle. This not happening, in May 1897 he was accused of forging the *petit bleu*, which had roused suspicion against Esterhazy. His bold action in repelling this charge hastened the revision of the case. He was retired from the army February 1898, having been arrested by the military authorities a month before. On 14 July he was again imprisoned in a civil prison; and 20 September was charged with forgery and with tampering with the Esterhazy telegram card. After a long imprisoment in the Cherche-Midi he was released and was the most prominent witness in the Rennes trial of 1899. At the retrial of the case 19 June–12 July 1906, he was acquitted of all charges, subsequently promoted brigadier-general and in October 1906 became Minister of War in the cabinet of M. Clemenceau, where he remained until 1909. See Dreyfus.

PICQUET. See Piquet.

PICRATE. See Piric Acid.

PICRIC ACID, or **TRINITROPHENOL**, $C_6H_2OH(NO_2)_3(1, 2, 4, 6)$, was discovered by Woulfe in 1771. It is formed by the action of nitric acid on indigo, wood, silk, leather, aloes, resins, and many derivatives of benzene. On a commercial scale picric acid is manufactured from phenol by first treating it with sulphuric acid. The sulphonic acid produced in this way is diluted with water to 30° Bé. and heated with steam. Phenol para-sulphonic acid is produced under these conditions which yields picric acid when it is nitrated with about 3.5 times its weight of nitric acid of 40° Bé. The crystals obtained on cooling the reaction mixture are washed, and further purified by recrystallization from hot water. A product of high purity may be obtained by converting the compound into the sodium salt and reprecipitating it with excess of hydrochloric acid. Very pure picric acid has been obtained directly by the nitration and subsequent hydrolysis of chlorobenzene, the reagents used being crude sodium nitrate and commercial sulphuric acid. Picric acid may also be prepared by the oxidation of trinitrobenzene, or, the nitration of diazobenzene sulphonic acid.

Picric acid is a yellow, crystalline substance with a melting point of 122.5° C. With many metals it forms salts which are highly explosive. It is not very soluble in cold water, but will readily dissolve in alcohol, ether, benzene and other solvents. Solutions of picric acid, especially those of its alkaline salts, show an intense yellow coloration. Picric acid is a violent explosive but does not readily explode on mere heating. Under ordinary conditions the application of heat may either cause rapid combustion, or sublimation with the liberation of yellow, irritating vapors. The acid will explode with violence when dropped upon a red-hot plate. Disastrous explosions in picric acid factories are on record. These have in all probability been caused by metallic picrates present as impurities in the acid, or, by the combustion of picric acid dust produced during the grinding of the dry compound. The acid can be handled with perfect safety, and can even be transported as an ordinary chemical when it contains 20 per cent of water.

Picric acid is extensively employed as a powerful explosive. Melinite, Lyddite, Shimosite, Emmensite, etc., are mixtures of the acid with small quantities of gun-cotton. On account of their great sensitiveness metallic picrates are sometimes mixed with chlorates or nitrates and employed as detonating charges for shells. Picric acid has been used as a dye for silk and wool. In an acid bath it imparts an intense yellow color to these fibres. Although the acid is not used as a dye at the present time, it is sometimes mixed with other dyes for the production of shades of scarlet, green or yellow. In the laboratory picric acid is a valuable reagent since it forms well crystallized and difficultly soluble compounds with a number of organic bases. Picric acid has also been used by brewers for the purpose of imparting bitterness to beer. In large doses the acid behaves as a poison, causing purging, vomiting and collapse, although small quantities have been employed with success in the treatment of eczema, erysipelas and in diseases of the skin and hair. Solutions of varying strengths have also been highly recommended in the treatment of burns.

V. S. Babasinian,
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PICROMERITE, a monoclinic mineral occurring as crystals and crystalline incrustations, a compound of hydrous sulphate of magnesium and potassium. It is found in the crater of Vesuvius and also in the salt mines of Stassfurt.

PICROTOXIN, a poison, $C_{30}H_{34}O_{13}$ (or possibly $C_{12}H_{14}O_5$), extract from the Indian berry, the fruit of the East Indian *Anamirta cocculus* or *paniculata*, by treating with hot alcohol the powdered seed. The alcohol is distilled, the residue boiled with water to which the acetate of lead has been added and the solution then evaporated. The crystals, white or transparent prisms or rays grouped in star-like forms, are very bitter to the taste, are odorless, inalterable in the air, insoluble in the essential oils, but soluble in cold water (150 times its bulk), boiling water (25 volumes), alcohol (3 volumes), or ether (2½ volumes), and are one of the most violent convulsive poisons known, closely resembling strychnine in their action. The poison brings death by asphyxiation after severe convulsion and is bulbo-medullary and not cerebral in its action. Morphine and chloral hydrate are the antidotes, but neither seems to have antidotic force if the original dose is much above the mortal minimum. In therepeutics picrotoxin is practically unused, though it is claimed to be valuable in epilepsy, chorea, chronic constipation, etc.

PICTET, pĕk-tā, or pē-tā, **Adolphe**, Swiss scholar and linguist: b. Geneva, 11 Sept. 1799; d. there, 20 Dec. 1875. He studied in Paris, Scotland and Germany; in 1838 became professor of æsthetics and philology in the University of Geneva; and wrote 'Du Beau dans la Nature, l'Art, et la Poésie' (1856), 'Les Origines indo-européennes' (1859–63), and on the relation of Celtic to Sanskrit. He invented a percussion howitzer shell used by the Austrian army.

PICTET, Raoul, Swiss physicist: b. Geneva, June 1842. He was professor in Geneva for a time, but removed to Berlin. In 1877 he liquefied oxygen, nitrogen and hydrogen; published a memoir on that subject in 1878; and also wrote 'Synthèse de la Chaleur' (1879), 'Nouvelles Machines frigorifiques' (1885), 'Le Matérialisme et le Spiritualisme par la Physique expérimentale' (1896), 'L'Acétylène' (1896), and other important monographs, on low temperatures and liquefaction of gases.

PICTON, pĭk'tŏn, Sir **Thomas**, English military officer: b. Poyston, Pembrokeshire, Wales, August 1758; d. Waterloo, Belgium, 18 June 1815. He entered the army at 13, served at Gibraltar, and in 1794 went to the West Indies, where he distinguished himself at Saint Lucia, Saint Vincent, Martinique and Trinidad, and in 1797 was appointed governor-general of the last-named island. In 1801 he became its civil governor and was promoted brigadier-general. He served in the Peninsular War under Wellington, received rank as lieutenant-general in 1813, was engaged with Ney at Quatre Bras in 1815 and was killed while leading a charge at Waterloo.

PICTON, Canada, town in Prince Edward County, province of Ontario, on an arm of the Bay of Quinte, about 36 miles southwest of Kingston. It has steamboat connection with the larger cities of the Dominion. Pop. 3,564.

PICTONES, pĭk'tŏn-ēz, or **PICTAVI** (*Pictŏnes, Pictāvi*), the ancient inhabitants of a region in Aquitanian Gaul, the French province of Poitou, which is now for the most part comprised in the Department of Vienne; the chief town of the Pictones was Pictava, modern Poitiers; before the Roman conquest of Aquitania its name was, as rendered by the Latins, Limonum.

PICTOR. See EQUULEUS.

PICTORIAL COMPOSITION. See ART DRAWING.

PICTORIAL REPRESENTATION. See ART DRAWING.

PICTOU, pĭk'too', Canada, a port of entry and capital of a county of the same name, Nova Scotia, 85 miles northeast of Halifax, on a branch line of the Intercolonial Railway. The town was settled in 1763 and occupies the site of an Indian village. Pictou Academy, organized in 1818, is its chief institution. There is a flourishing motor boat industry. The harbor is safe and commodious and an active export trade is carried on in the coal and building stone of neighboring mines and quarries, in agricultural produce and fish. Pictou Island lies about six miles outside the harbor. Pop. (estimated) 3,179.

PICTS. See SCOTLAND.

PICTURED ROCKS, in Michigan, sandstone cliffs about 300 feet in height, extending along the coast of Alger County, on the south shore of Lake Superior, about 43 miles east of Marquette. They are varied in color and form, quaint designs have been carved upon them by the elements and a number of waterfalls still continue the work of change. The cliffs are about five miles long. Longfellow, in his Indian tale of Hiawatha, locates the wigwam of Nokomis at Munising Harbor, among the Pictured Rocks.

PICTURES OF TRAVEL (Reisebilder), the most famous of the prose works of Heinrich Heine. It was published in four parts, 1826-31, and the appearance of the first book of these sketches marked an epoch in the development of German literature. It was read with avidity by the public and so strong was its influence that it gave the first serious check to a prevailing tendency in the world of letters — the romantic tendency. The power of the Romantic School was broken by the vivid realism of Heine's 'Hartz Journey.' The keen observation of the great lyrist and satirist, his brilliant searching criticisms of men and institutions, his stinging sarcasms poured out on existing conditions, were entirely opposed to the spirit of Romanticism, and its author attained at once to almost as widespread a recognition as he was ever to reach among his countrymen. The brilliancy and bitterness, the sweetness and the mockery, of his strange nature, are all brought into play in this, his first prose work of significance.

PICUDA, a fish. See BARRACUDA.

PICUL, a Chinese weight of about 140 pounds; the same as tan. It is divided into 100 catties, or 1,600 taels. Also spelled pecul and pecal.

PICUS, pī'kŭs (Lat., the woodpecker), in the most ancient mythology of the Sabines, Latins and Etrurians, the sacred bird of the god of the upper atmosphere, of the land and agriculture, sender of rain, giver of fertility. This god was Mars, Mavors or Marspiter (*Mars pater*, father Mars), who afterward was supplanted by the more than half-Grecian god Jupiter (father Jove), while Mars or Mavors was assimilated to the Grecian god of war, Ares. The Latin god Mavors gave oracles by means of the noises made by the woodpecker tapping on the trees. In the confusion of the diverse mythologies, Sabine, Roman, Latin, Etrurian, the woodpecker, Picus became a form of the god himself, or son of the god and a famous hero, king of Latium, and father of Faunus.

PIDAL, pē-däl, **Ramón Menédez,** Spanish philologist, critic and educationalist: b. Coruña, 13 March 1869. Educated at the universities of Madrid and Toulouse he became professor of Roman philology at the former university (1899). His markedly critical mind, his mastery of the French tongue and his extensive writings soon won for him an international reputation and he was invited to lecture in the universities of various foreign countries, principally those of South America. He has also given courses of lectures in Johns Hopkins University (1909), the Turnbull lectures; and in most of the universities of Spain. He also delivered the Hispanic Society lectures at Columbia University in 1909. Thus he came to be recognized as one of the foremost and most progressive educationalists in Spain. Shortly after the formation of the Junta para Ampliación de Estudios (a board created in 1907 for the extension and improvement of university studies throughout Spain), he became a member of the organization and director of its summer session; and in 1913 Counselor of Public Instruction in Spain. His services in these and other educational and literary capacities gained for him membership in practically all the noted literary organizations of his native country, among them being the Royal Academy of History, Madrid, and the Academia Real de la Lengua; and also of the Hispanic Society of America. The Academía Real de la Lengua crowned his 'Gramática y vocabulareo de poema del Cid,' and the same honor was extended to his 'Leyenda de los infantes de Lara' by the Royal Academy of History. In the field of Spanish philology he occupies a distinguished place which may be said to make him a noted specialist in his line of work. Among his published works are 'L'Epopéc castillane à travers la littérature espagnole' (his Turnbull lectures, 1910); 'El Romancero español' (Hispanic Society Lectures at Columbia); 'Gramatica Historica Española'; 'Leyenda de abad Don Juan de Montemayor'; 'Primera crónica general'; 'Cantor de mio Cid' (3 vols., 1908-

11); ‘Cancionero de romances impreso en Amberes sin Ano’ (1914).

PIDAVRO. See Epidaurus.

PIDDIG, pē-dēg′, Philippines, pueblo, province of Ilocos Norte, Luzón; on the Guisi River, near its junction with the Pagsán; nine miles east of Laoag, the provincial capital. It is connected with Laoag and other towns by wagon road. Pop. 10,850.

PIDDOCK, the British name for certain edible species of mollusks of the genus *Pholas*. See Date-shell.

PIDGIN, pĭj′in, **Charles Felton,** American statistician and novelist: b. Roxbury, Mass., 1 Nov. 1844. He was in mercantile employment in Boston 1863–73, becoming in the latter year chief clerk of the Massachusetts bureau of statistics of labor. He has invented several machines for the mechanical tabulation of statistics, among them the electric adding and multiplying machine, addition register and typewriter tabulator. He has published ‘Practical Statistics’ (1888); ‘Quincy Adams Sawyer’ and ‘Mason's Corner Folks’ (1900); ‘Blennerhassett’ (1901); ‘Stephen Holton’ (1902); ‘The Climax’ (1902); ‘Little Burr’ (1905); ‘Theodosia’ (1907); ‘Labor, or the Money God’ (1908); ‘Further Adventures of Quincy Adams Sawyer’ (1909); ‘Chronicles of Quincy Adams Sawyer, Detective’ and ‘The House of Shame’ (1912); ‘The Courtin’’ (a comic opera, 1913). He has also composed several musical works, among them ‘Cambyses,’ a grand opera, and ‘Peck's Bad Boy,’ a musical comedy. He is also the author of some 35 songs.

PIDGIN, or PIGEON, ENGLISH, a form of «business English»; a conglomeration of English and Portuguese words wrapped in a Chinese idiom, used by English and American residents in China in their intercourse with the natives. It accommodates the Chinese inability to sound the *r*, which is always *l*, and it adds the long *ē* or *ee* (double *e*) after consonants that trouble the Chinese tongue. Thus price becomes «plice,» and wash is «washee.» Some pidgin English has drifted into American use as «chow-chow,» meaning food, or as a verb, to eat; and «savey,» which is accepted slang for know.

PIED (pīd) **PIPER OF HAMELIN, The,** according to a legend a magician who promised to rid the town of Hamlin from rats for a stipulated sum of money. He performed his task by playing on his pipe as he walked to the river and the rats, following the music, were consequently drowned. On the citizens then refusing to pay the money the piper took up his pipe once more and led the way out of the town followed by 130 children. On arriving at a hill known as the Koppenberg they all entered the hill and vanished from sight. In the Hamelin Rathaus the event is recorded and it was long supposed to be historical. Browning's poem, ‘The Pied Piper of Hamelin’ (1842), is based on this tale.

PIEDMONT, pēd′mŏnt (Italian, *Piemonte*, «Country at the Foot of the Mountains»), Italy, a compartment including the provinces of Cuneo, Alessandria, Novara and Torino. It is separated from France and Switzerland by the Alps. It was a part of France from 1797 to 1814, and was at one time the chief part of the kingdom of Sardinia (q.v.). In 1911 there were 26,332 industrial establishments in the territory, giving employment to 342,354 people. Silk culture is a flourishing industry. Farming is carried on mainly on shares, the tenant dividing with the proprietor. The area is 11,331 square miles; pop. 3,508,626. See Italy.

PIEDMONT, Battle of. After the battle of New Market (q.v.), 15 May 1864, General Sigel was relieved, and 21 May General Hunter was assigned to the command of the Union forces in the Shenandoah Valley. The command in the field consisted of Gen. J. C. Sullivan's division of infantry, two brigades, under Colonels Moor and Thoburn; Gen. J. Stahel's division of cavalry, two brigades, under Colonels Tibbits and Wynkoop, and five batteries of artillery. With this force of 8,500 men and 21 guns, Hunter broke camp on Cedar Creek on the 26th to move on Staunton and Lynchburg, marched to Woodstock, and thence to Harrisonburg, where, 2 June, he learned that General Imboden was at Mount Crawford, eight miles distant, barring the direct road to Staunton. He avoided Imboden by passing his right by way of Port Republic. From his camp one mile south of Port Republic he advanced early on the morning of the 5th on the Staunton road, met the Confederate cavalry at 6 A.M., and drove them after a sharp skirmish, with a loss of 75 men killed, wounded and missing. At Piedmont, seven miles southwest of Port Republic, Hunter found Gen. W. E. Jones with a Confederate force of 6,000 men and 12 guns, strongly posted, his left resting on Middle River, a tributary of the Shenandoah. Line was formed; Moor's brigade on the right; Thoburn's on the left; Wynkoop's cavalry massed in rear of Moor. Hunter's artillery opened at 9 A.M., and after a fire of less than two hours Moor attacked the Confederate left and drove the first line back on the second, which was on a curving ridge of heavily wooded hills, and on reaching which Moor was checked and fell back with some loss, the Confederates following, but soon checked in turn by Moor, aided by the cross-fire of three batteries. Meanwhile Thoburn had crossed a ravine to gain the Confederate right flank. Securing an advantageous position, he made a charge on the woods and heights; there was a fierce struggle, in which bayonets and clubbed muskets were used on both sides; Moor and Wynkoop co-operated in the attack; and the Confederates abandoned their position in great disorder, leaving General Jones dead on the field, with more than 1,000 prisoners, including 60 officers. In killed and wounded the Confederate loss was about 600. The next day Hunter captured 400 sick and wounded. Three guns, several battle-flags, and a large number of small arms were captured. Hunter's loss was 420 killed and wounded. General Vaughn, who succeeded Jones in command, fled with not over 3,000 effective men to Waynesboro, and abandoned Staunton. Hunter marched to Staunton on the 6th, where he was joined on the 8th by Generals Crook and Averell, who had marched from West Verginia, with 10,000 men, raising his force to 18,000 men, with 30 guns. He destroyed much public property in Staunton, broke the railroad several miles east and west of it, and on the morning of the 10th marched for Lynchburg. Consult 'Official Records' (Vol. XXXVIII); Pond, 'The Shenandoah Valley in 1864'; The Century Company's 'Battles and Leaders of the Civil War' (Vol. IV).

PIEDMONT ALLUVIAL PLAINS. See Alluvial Fans.

PIEDMONT PLAIN, the name given to that part of the Atlantic coastal plain, in the United States, which lies between the Appalachian highland and the coastal plain proper. This plain is well defined in the Southern States, but not so distinct in New England. It is nearest to the ocean in New York; in North Carolina it is about 300 miles wide. It is crossed by deep river valleys, and is seamed with rugged gorges, and water beds. The rock is harder and older than in the coastal plain proper, belonging chiefly to the Pre-Cambrian. The «fall line,» or escarpment over which the Atlantic rivers fall and form cascades and rapids, marks the change from the hard rocks of the Piedmont to the softer rock formations of the Coastal Plain.

PIEDS PUIDREAUX, pē-a pwē-drō. See Piepowder Court.

PIEGAN (pē'gạn) **INDIANS,** an American tribe of the Algonquin family. Some 2,000 of them reside on the Blackfoot Reservation in northern Montana. They are members of the Siksika confederacy, being associated with the Siksikas, Bloods and other tribes. They are a very peaceable people and crime is almost unknown among them.

PIEHL, pēl, **Karl,** Swedish Egyptologist: b. Stockholm, 30 March 1853; d. 1904. He was educated at Upsala, where he became docent of Egyptian languages in 1888, and in 1893 professor upon a special grant by the Riksdag. He published 'Inscriptions hiéroglyphiques' (1884–99), 'Petites Etudes égyptologiques' (1881), 'Dictionnaire du Papyrus Harris Nr. 1' (1882), and many contributions to archæological periodicals. In 1896 he became editor of *Le Sphinx*, an Egyptological journal.

PIENG-AN. See Ping-Yang.

PIENO (Ital., meaning full), a term often used in music as equivalent to *tutti, grande* or *grossi*, to signify employment of all the instruments of an orchestra; sometimes it is used with *coro*, as *pieno coro*, full chorus.

PIEPER, Franz August Otto, American Lutheran theologian: b. Carwitz, Pomerania, Germany, 27 June 1852. Coming to the United States, he was graduated from Northwestern University, Watertown, Wis., in 1872, and from Concordia Seminary in 1875. He held a Lutheran pastorate at Manitowoc, Wis., 1875–78, was professor of theology at Concordia Seminary 1878–87, and president of the latter institution since the year last named. Among his many published works are 'Lehre von der Rechtfertigung' (1889); 'Wie studiert man Theologie?' (1898); 'Lage der Kirche am Anfang des 20 Jahrhunderts' (1901); 'Die Grunddifferenz' (1904); 'Conversion and Election' (1913).

PIEPOWDER (pī'pow-dėr) **COURT,** or **PIERPOUDRE COURT,** a court formerly set up at fairs and markets in England for the summary administration of justice in cases arising there. It is also called the Court of Dusty Foot, which has the same meaning as piepowder (a corruption of the French *pied poudreux*), and probably got its name from the fact of its being chiefly resorted to by peddlers and wayfaring persons, to whom the name of *pieds puidreaux* was given in Old French.

PIER, Arthur Stanwood, American novelist: b. Pittsburgh, 21 April 1874. He was graduated from Harvard in 1895, and has been an assistant editor of the *Youth's Companion* from 1896. He has published 'The Pedagogues' (1899); 'The Sentimentalists' (1901); 'The Triumph' (1903); 'Boys of Saint Timothy's' (1904); 'The Ancient Grudge' (1905); 'Harding of Saint Timothy's' (1906); 'The Young Mr. Heart' (1907); 'The New Boy' (1908); 'The Crashaw Brothers' (1910); 'The Jester of Saint Timothy's' (1911); 'The Story of Harvard' (1913); 'The Women We Marry' (1914); 'Grannis of the Fifth' (1914).

PIER, *in engineering,* a structure extending out from the land into the water, adapted to form a landing place for passengers or merchandise from ships which float in the deep water alongside the pier or wharf; a mole or jetty. Many large and commodious piers have been built at watering places to receive incoming visitors and these are often fitted up with booths, bandrooms, dancing pavilions, etc. They are variously constructed. Some are founded on piles, with cross timbers, braces and sheathing; floor timbers affording a road for the traffic. The wooden structure is sometimes filled up with stone, like a dike; at other times it is of the nature of trestle work. The name is extended to any plain single mass of masonry supporting a large structure, as a bridge pier, foundation pier. A section of a brick or stone wall between windows is also termed a pier, whence comes the term pier-glass, for a long mirror suited to such a position. See Foundations; Dock; Mole; Wharf.

PIERCE, pērs, **Franklin,** 14th President of the United States (1853–57): b. Hillsboro, N. H., 23 Nov. 1804; d. Concord, N. H., 8 Oct. 1869. His father, Benjamin Pierce (1757–1839), served in the Revolutionary War, was member of the State legislature 1789–1801, and from 1803 to 1809. He was a Democrat in politics, an active public-spirited man, and governor of New Hampshire from 1827 to 1829. His son, therefore, was brought up in an atmosphere of public service. Franklin Pierce was educated at various academies, Hancock, Francestown and Phillips Exeter, entered Bowdoin College, Maine, 1820, and had as classmates Longfellow and Hawthorne. He graduated third in his class in 1824 and studied law for the next three years, first with Levi Woodbury at Portsmouth, then at the law school of Judge Howe at Northampton, Mass., and finally with Judge Edmund Parker at Amherst, N. H. He was admitted to the bar in 1827 and entered politics almost immediately as a Democrat. In 1829 he was elected as a representative to the State legislature, and in 1832 was made speaker. In 1833 he entered Congress, became a close friend of Jackson and sustained him in important contests. His career in the House of Representatives during the next four years was uneventful, because most of his work was done in the committee-room. He rarely made a speech, and then not on the most important questions. He spoke 27 Feb. 1834, against the bill on the subject of Revolutionary claims, on the ground of economy and justice; and on 30 June 1836 against the bill making appropriations for the United States Military Academy, on the ground that it was legislation conferring «exclusive and gratuitous privileges.» He approved of Jackson's veto of the Maysville road bill, and in general was a believer in a strict construction of the Constitution. In December 1835 he spoke and voted against the policy of receiving petitions for the abolition of slavery in the District of Columbia. In 1837 Pierce was elected to the Senate, but was overshadowed by such men as Clay, Calhoun, Webster and Benton, Pierce being the youngest of all the senators. He seldom spoke and avoided, as in the House, the big questions of the day. He resigned in 1842 to accept the office of district attorney of New Hampshire.

When the Mexican War broke out in 1846, he enlisted as a private, enrolled in a company of volunteers organized at Concord, and soon received from the President a commission as colonel of the Ninth regiment. On 3 March 1847, he was commissioned as brigadier-general in the volunteer army, though practically without military experience. He was with General Scott in the march on the City of Mexico, but did not play a conspicuous part in the military operations. After his return home he engaged in the practice of law. The Democratic National Convention met at Baltimore 1 June 1852, with Lewis Cass, James Buchanan and Stephen A. Douglas as the leading candidates. On the 35th ballot the Virginia delegation voted for Pierce, and on the 49th he received 282 votes to 6 for all other candidates. This «dark horse» Presidential candidate was a real surprise to most people. The reasons for passing by the three leading candidates mentioned above were varied. Since each had a large following there was bitter personal rivalry, and this made the success of any one a matter of considerable doubt. The chief concern of the leaders was to placate the South and avoid the growth of a purely sectional party. Accordingly, the convention adopted a resolution pledging the party to enforce the compromise of 1850. Pierce was favorable to the institution of slavery, believing that it was guaranteed by the Constitution, and was thus considered a «safe man» by the South. In the election which followed in November, he received 1,601,474 popular votes to 1,386,580 for Gen. Winfield Scott, the Whig candidate, and at the meeting of the electoral college 254 votes to 42 for Scott. All of the States voted for Pierce excepting Vermont, Massachusetts, Tennessee and Kentucky. He was inaugurated 4 March 1853, and on March 7 announced his Cabinet, namely, William L. Marcy of New York, Secretary of State; James Guthrie of Kentucky, Secretary of the Treasury; Jefferson Davis of Mississippi, Secretary of War; Robert McClelland of Michigan, Secretary of the Interior; James C. Dobbin of North Carolina, Secretary of the Navy; James Campbell of Pennsylvania, Postmaster-General, and Caleb Cushing of Massachusetts, Attorney-General.

The election of Pierce may be considered primarily as a verdict in favor of carrying out the terms of the compromise of 1850 and the policy of expansion. In his first inaugural address Pierce said: «The policy of my administration will not be controlled by any timid forebodings of evil from expansion.» He also declared that «our position on the globe renders the acquisition of certain possessions not within our jurisdiction eminently important for our protection.» This doubtless referred to Cuba, much desired by the southern expansionists for additional slave territory. Pierce appointed Pierre Soulé of Louisiana as Minister to Spain, a man who had previously declared in open senate his desire to annex Cuba to the United States by some other method than by purchase. In August 1854, Secretary of State Marcy suggested that Soulé, James Buchanan, and John Y. Mason, ministers respectively to Spain, England and France, have «a full and free interchange of views» in regard to the acquisition of Cuba. The result was a meeting at Ostend, where on 9 Oct. 1854 they drew up the famous Ostend Manifesto, in which Spain was urged to sell Cuba to the United States, and in case of refusal the question should be considered whether the interests of the United States were endangered by Cuba remaining in the possession of Spain. If answered in the affirmative, then «by every law, human and divine, we shall be justified in wresting it from Spain if we possess the power.» The exact relation of Pierce to this document is not fully known. It was disavowed by Secretary of State Marcy in the name of the President, but Pierce was held as more or less responsible for the incident by his enemies.

Moreover it was during the administration of Pierce that William Walker carried out his notorious filibustering expeditions in Central America, for the purpose of setting up a government under American rule favorable to slavery. In June 1855 he entered Nicaragua with a small force, captured Granada on 13 October, procured his election as President in July 1856, and proclaimed Nicaragua a slave State. His dominion was recognized by the American minister resident, and Pierce received Walker's envoy, though he had previously issued proclamations warning the people against armed expeditions to countries with whom the United States was at peace. Ministers from other Central American republics protested against this violation of neutrality, but to no purpose.

Pierce supported several other policies of importance. He wished to expand American commerce as rapidly as possible, first by federal subsidies to shipping and second by opening up new areas for trade. Commodore Perry was sent to Japan to induce this nation to open her ports to American trade and was successful in his mission. Pierce also supported the plan of linking California more closely with the rest of the country by means of a transcontinental railroad. The best route lay through territory, a portion of which was in the possession of Mexico. Accordingly James Gadsen was sent to Mexico to purchase a strip of territory on the southern border of New Mexico. He secured a tract of some 50,000 square miles for $10,000,000, which was known as the Gadsen purchase. The railroad was planned largely to benefit the economic development of the lower

FRANKLIN PIERCE

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South, and Congress voted the funds for the survey of routes. Pierce advocated the building of the railroad in his first annual message, and handed over the work of seeing to the survey to Jefferson Davis.

Another policy was the opening up of the Northwest to settlement. The platform of the Democratic party declared that the party “will resist all attempts at renewing, in Congress or out of it, the agitation of the slavery question, under whatever shape or color the attempt may be made.” Pierce also, in his inaugural address, advised against the reopening of the slavery question. Nevertheless the conflict over the extension of slavery into the territories was the great event of his administration. The occasion was the plan of Senator Douglas to open up the great Northwest to settlement, remove the Indians to reservations or to the Southwest, connect Chicago with the Pacific Northwest by a railroad, open the territory to slavery and thereby become the next President of the United States. The supremacy of the Northwest was at stake and this was a plan to checkmate the South for a Southern Pacific railroad. Douglas won the support of the Middle West, western Missouri, and powerful interests in the South. This last because of a promise that the Kansas-Nebraska bill should contain a clause giving settlers the right to determine for themselves whether they would have slaves — the doctrine of popular sovereignty. Thus the Missouri Compromise of 1820 prohibiting slavery in the Louisiana territory north of 36° 30′, except Missouri, would be repealed. Pierce gave his support to this plan and signed the bill. Thus he aided the South in its desire for the extension of slavery into the territories, although the most of the Northwest would in the end naturally become free territory. This action of Pierce wrecked his administration. He immediately organized Kansas and Nebraska as territories, and supported the pro-slavery party in Kansas during the remainder of his term of office, in an effort to prevent the admission of Kansas as a free State. Thus he helped make the Democratic party of the North subservient to that of the South, and supported the slave power in its extreme demands for more slave territory. He believed that this would satisfy the South and thus disunion and civil war would be avoided. He was under the influence of Jefferson Davis, his Secretary of War, and this accounts, in part, for his attitude on several important public questions. After his retirement from the presidency he traveled in Europe for three years, returning home early in 1860. He was opposed to the methods of the Abolitionists, but supported the North when war broke out.

Pierce did not measure up to the standard of most of the Presidents. He was not a commanding figure in any field. He was honest in his intentions as a conciliator of the two sections, in his belief that the Constitution guaranteed slavery as an institution, and that the way to avoid civil war and disunion was to support the South in this view. His strong leaning toward the South, however, really had the effect of promoting sectional strife and finally in leading to civil war. He was an amiable, honest, generous, modest, educated gentleman, but lacked intellectual acumen and that idealism necessary for great leadership. His chief stock in trade was attention to legislative details, fidelity to party, winning manners, and a neutral compromising character which was a negative rather than a positive and constructive force. His last years were passed at his home at Concord, N. H., beloved by his personal friends but almost forgotten by his countrymen.

Bibliography.— There is no good life of Pierce. The early biographies were published for campaign purposes and do not cover his term of office. Consult life by Bartlett, D. W. (Auburn N. Y., 1852), and by Hawthorne, Nathaniel (Boston 1852), both eulogistic accounts; Ireland, J. R., ‘History of Life and Administration and Times of Franklin Pierce’ (Chicago 1888), in Vol. XIV of his Republic. See also Richardson, J. D., ‘Messages and Papers of the Presidents’ (Washington 1897); Leech, W. L., ‘Calendar of the Papers of Franklin Pierce’ (Washington 1917). Some of his correspondence is printed in *American Historical Review,* Vol. X, 110–127, 350–370. The best accounts of his administration are in Schouler, James, ‘History of the United States’ (New York 1894), Vol. V; Rhodes, James Ford, ‘History of the United States from the Compromise of 1850’ (Vols. I–II, New York 1900); von Holst, Hermann, ‘Constitutional History of the United States’ (Vols. IV and V, Chicago 1899).

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PIERCE, George Foster, American Methodist bishop, son of Lovick Pierce (q.v.): b. Greene County, Ga., 3 Feb. 1811; d. near Sparta, Ga., 3 Sept. 1884. He was graduated from Franklin College, Athens, Ga., in 1829, and entered the ministry in 1831. He attained great popularity as a preacher, was president of the Georgia Female Seminary, Macon, Ga., in 1839–42, of Emory College, Oxford, Ga., in 1849–54 and was elected bishop in the latter year. He was a member of the convention which met at Louisville, Ky., in 1846, and organized the Methodist Episcopal Church, South, and was prominently connected with it until his death. Consult ‘Life’ by George G. Smith (1888).

PIERCE, Lovick, American Methodist clergyman: b. Halifax County, N. C., 17 March 1785; d. Sparta, Ga., 9 Nov. 1879. He entered the Georgia Conference in 1805, was chaplain in the army in the War of 1812, and afterward studied medicine, which he practised until 1821, when he re-entered the ministry. He was prominently connected with the organization of the Methodist Episcopal Church, South, in 1846, and was famous for pulpit eloquence.

PIERIANS, pĭ-ē'rĭ-ạnz, or **PIERIDES,** pĭ-ĕr'ĭ-dēz, a name given the Muses, from their birthplace, Pieria in Thessaly.

PIERIDÆ, a large family of butterflies, of medium or large size, and chiefly white and yellow in their coloration, and represented in all parts of the world. They are distinguished from their nearest relatives, the *Papilionidæ* (q.v.), by the fact that all six legs are fully developed in both sexes; and from the *Hesperidæ* and *Lycænidæ,* by the greater specialization of the neuration of the wings.

The widespread «cabbagewhite» is a typical representative. A well-known American genus is that of the orange-tips.

PIERNÉ, pē-är-nā, **Gabriel**, French organist and composer: b. Metz, Germany, 1863. He was graduated from the conservatory at Paris and in 1882 won the Prix de Rome; in 1890 he was appointed organist at Saint Clothilde and has since devoted much time to composition. His operas have been very successful, particularly 'Izéil' (1894): He brought out the oratories of 'Les Enfants de Bethlehem' (1907), and 'Saint Francois d'Assisi' (1913).

PIERO DI COSIMO, pē-ä-rō dē kō-sē-mō, Italian painter: b. Florence, about 1462; d. there, 1521. He was a pupil of Casimo Roselli and at times was influenced by Signorelli, Filippino and Leonardo da Vinci. He devoted himself to landscape backgrounds, which were always ably executed, if somewhat fantastic in character. This feature is especially notable in his 'Death of Procris' (National Gallery, London). His pictures are somewhat rare, though the galleries of Florence, Rome, Paris and London possess several specimens.

PIERO DELLA FRANCESCA. See Francesca, Piero Della.

PIEROLA, pē-ä-rō'lä, **Nicholas de**, Peruvian politician: b. Camana, Peru, 5 Jan. 1839; d. 1913. He was educated in the college of Santo Toribio in Lima, admitted to the bar in 1860 and was connected with various journalistic enterprises. In 1869–72 he was Minister of Finance under President Balta. Impeached under the administration of Pardo, he came to the United States, though acquitted, and interested himself in revolutionary schemes. At the outbreak of the war between Chile and Peru his services were accepted by President Pardo and he returned to Peru in 1879. Upon the flight of Pardo he headed a revolt against the government, but was defeated. In 1885 he was banished for attempting to seize the presidency, but in 1894 headed a revolt which succeeded in overthrowing President Cáceres. Pierola was thereupon elected President and served until the end of his term in 1899.

PIERPONT, pēr'pŏnt, **Francis Harrison**, American politician: b. Monongalia County, Va. (now West Virginia), 1815; d. Pittsburgh, Pa., 24 March 1899. He was graduated from Allegheny College, Meadville, Pa., in 1839, was admitted to the bar and established a law practice in Fairmount, Va., where he soon became widely known. He was a staunch Whig and Abolitionist and at the outbreak of the Civil War remained loyal to the Union, organized the convention which decided that the western part of Virginia should remain in the Union and was elected governor of the «Restored Government of Virginia.» He was recognized by President Lincoln, authorized to raise troops for home protection and after serving two years of the unexpired term was re-elected for a term of four years. After the organization of West Virginia as a State and her admission into the Union Governor Pierpont removed his capital to Alexandria and after the evacuation of Richmond transferred the government to that city, where he continued as governor of the loyal section of the State until 1868. In 1868–70 he served in the legislature and afterward lived in retirement until appointed internal revenue collector by President Garfield.

PIERPONT, James, American mathematician: b. about 1863. In 1886 he was graduated at the Worcester Polytechnic Institute and in 1894 he received the degree of Ph.D. at the University of Vienna. In 1899 he received the honorary degree of M.A. from Yale University and in 1909 that of LL.D. from Clark University. In 1894–95 Pierpont was lecturer in mathematics, in 1895–96 instructor, in 1896–98 assistant professor at Yale. Since 1898 he has been full professor there. His published works are 'Lectures on the Theory of Functions of Real Variables' (1905); 'The History of Mathematics in the Nineteenth Century' (1905); 'Functions of a Complex Variable' (1914).

PIERPONT, John, American Unitarian clergyman and poet: b. Litchfield, Conn., 6 April 1785; d. Medford, Mass., 27 Aug. 1866. He was graduated from Yale in 1804, studied law at Litchfield and after admission to the bar of Essex County, Mass., practised for a short time at Newburyport. Later he studied theology and in 1819 was ordained pastor of the Hollis Street Church in Boston. His outspoken views on temperance, anti-slavery and other reforms occasioned his dismissal from the parish in 1845, and he was subsequently pastor of Unitarian churches at Troy, N. Y., and Medford, Mass. His 'Airs of Palestine,' first issued in 1816, was republished in a volume entitled 'Airs of Palestine, and Other Poems' (1840). He also published 'Anti-Slavery Poems' (1843). One of his best-known poems is 'Warren's Address at the Battle of Bunker Hill,' and the pathetic lines on the death of his son are still remembered.

PIERPOUDRE COURT. See Piepowder Court.

PIERRE, pē-är' So. Dak., city, capital of the State, county-seat of Hughes County, on the Missouri River, and on the Chicago and Northwestern Railroad, near the central part of the State. It was settled in 1880 and incorporated in 1883. It is in an extensive farming and stock-raising region, and in a natural gas belt. Its industries are chiefly connected with farm products, natural gas and the shipment of cattle. About 1,000 carloads of livestock are exported each year from this city. It is the seat of a Government Indian Industrial School, it has public and parish schools, a public library, and Saint Mary's Hospital. It has two daily newspapers and good banking facilities. The city owns and operates the gas plant, electric-light plant and waterworks. Pop. 3,656.

PIERREPONT, pēr'pŏnt, **Edwards**, American jurist and diplomat: b. New Haven, Conn., 4 March 1817; d. New York, 6 March 1892. He was graduated from Yale in 1837, admitted to the bar in 1840, established a law practice in Cincinnati, Ohio, where he remained until 1845, when he removed to New York. In 1847 he was elected judge of the Superior Court of New York, resigning in 1860. In 1862 he was appointed by President Lincoln to conduct with John A. Dix the trials of the prisoners of State, and in 1864 actively supported Lincoln in the Presidential campaign. He was prosecutor for the government of John

H. Surratt, indicted for complicity in the assassination of Lincoln, and in 1869–70 was United States district attorney for southern New York. In 1870 he was one of the committee of 70 which fought the Tweed ring, and in 1875 became Attorney-General of the United States, which office he resigned in 1876 to accept the appointment of Minister to England. He resigned this post in 1878, and resumed his law practice.

PIERROT, pē-ā-rō', in France one of the characters that appear in pantomime. The pierrot is a cunning and shameless poltroon, whose delight is in mischief or roguery. His dress is white, very wide and loose, with huge buttons.

PIERS PLOWMAN. See LANGLANDE, WILLIAM.

PIERSON, pēr'sōn, **Abraham**, American educator: b. Lynn, Mass., about 1641; d. Killingworth, Conn., 7 March 1707. He was graduated from Harvard in 1668, ordained in the following year, served in charge of various pastorates and in 1700 was one of the founders of Yale College, of which he became the first president in 1701. He remained in that office until his death in 1707.

PIERSON, Arthur Tappan, American Presbyterian clergyman: b. New York, 6 March 1837. He was graduated from Hamilton College, Clinton, N. Y., in 1857, and was a Congregational minister until 1863, when he entered the Presbyterian body. He has held many important pastorates in the United States, was pastor of the Metropolitan Tabernacle in London in 1891–93, and of Christ Church, there, in 1901–03. He has lectured on missions in the United States and in Scotland and is author of: 'Keys to the World' (1888); 'Heart of the Gospel' (1892); 'New Acts of the Apostles' (1894); 'The Gordian Knot' (1902); 'The Keswick Convention' (1903), etc.

PIERSON, Israel Coriell, American actuary: b. Westland, N. J., 22 Aug. 1843. He was graduated from the University of the City of New York in 1865. He is actuary of the Washington Life Insurance Company and first vice-president of the Actuarial Society of America, of which he was secretary 1889–99.

PIETER DE HOOCH (or **HOOGH**), pē tėr dė hōн (hōg), Dutch painter: b. about 1630; d. about 1681. Very little is known of the life of this painter, of whom no authenticated portrait exists and a number of contemporary Pieter de Hoochs have added confusion to the various printed accounts. His birthplace is unknown, but from documentary evidence he seems to have been living at The Hague from 1653 to 1655, where he was employed as servant to a merchant, Justus de la Grange and painted pictures as he had opportunity. He is recorded, 20 Sept. 1655 as a member of the Painters' Guild of Saint Luke at Delft. Two years later he is lost sight of and remains in obscurity until he is found in Amsterdam in 1668. Here he came under the influence of Rembrandt, an influence of highest importance to his art. No picture of de Hooch is dated later than 1677 and it is assumed that he died shortly afterward. He is a painter of genre subjects, choosing for the most part Dutch interiors, though there exist a number of exterior scenes — scenes of cottage life outdoors, where the landscape features are ably handled. Though several of his pictures exhibit animated groups of people, he for the most part relegates the human element to a subordinate position and paints sunlight as his principal object. His reputation has increased in recent years; the English, who possess many of his best works, being earliest in showing their appreciation. His greatest works are 'The Country House' and 'The Battery' in the Ryks Museum, Amsterdam; the 'Card Party' in the Louvre and the 'Dutch Interior' in the National Gallery. An 'Interior' is in the Metropolitan Museum, New York and other examples in the private collections of C. F. Yerkes of Chicago and H. O. Havemeyer, New York.

PIETERMARITZBURG, pē-tėr-mär'its-boorg, or simply **MARITZBURG**, South Africa, the capital of Natal, situated on an elevated plain, 2,200 feet above sea-level, 70 miles by rail west-northwest of Durban, on the river Umsindusi, a tributary of the Umgeni. It is a thriving and pleasant town, well laid out, with broad streets, many planted with trees and lighted by gas and electricity. It contains several handsome public buildings including the Legislative Council building, in front of which is a white marble statue of Queen Victoria. Pietermaritzburg is the seat of an Anglican bishopric and among its churches are two cathedrals. Its educational institutions include a library, a small museum, Maritzburg College and several public schools, an Anglican college for girls and a Roman Catholic convent. The town has several reserves for recreation purposes, the chief being Alexandra Park. The Botanic Gardens are situated a short distance from the town. The extensive waterworks cost about $300,000. Fort Napier contains the barracks. The chief industries are the building of carts and wagons, tanning, brickmaking and brewing and there is some trade in hides, etc. Pietermaritzburg was founded by Boers in 1839 and derives its name from two Boer leaders, Pieter Retief and Gert Maritz. It was incorporated in 1854 and the railway was opened in 1880. The assessed valuation of realty is over $20,000,000. Pop. (estimated) 30,555, of whom half are white, one-fourth Asiatics and Indians and one-fourth blacks.

PIETISM, a religious movement in the Lutheran churches of Germany, which had its rise toward the end of the 17th century. Like Methodism and Methodist, Pietism and Pietist were originally terms of contempt bestowed on religious innovators by their conservative opponents. The author of the Pietist movement was Philip James Spener, a Lutheran pastor at Frankfort on the Main who in 1670 began to hold private conferences in his own house with devoutly inclined people, in which the Scriptures were explained with a view solely to the promotion of inward piety instead of the inculcation of dogmatic beliefs. In a book entitle 'Pia Desideria' (1675) he sought to bring the Lutheran Church back to its original principles. That Church, the foundation principle of which was, for Luther, Christian faith in the heart and acceptance of the Scriptures as the supreme rule of life and belief, had become a creed-bound institution with an inflexible system. In the pulpits the dogmas of the creeds were continually expounded and defended, while the Bible was made of no account by preachers and pastors, in the theological schools or in the family. The true pastoral work of the Christian ministry, that of forwarding the moral and spiritual welfare of the people, was in desuetude. To remedy these evils Spener proposed in his work: (1) Cultivation of devout study of the Scriptures in private meetings; (2) Recognition of the Christian priesthood of all the faithful by giving to the laity a share in the government of the Church; (3) Insistence, in pulpit discourse, upon the necessity of vital personal piety; (4) Kindly persuasion instead of polemic bitterness in dealing with heretics and unbelievers; (5) Making theological seminaries schools of personal piety no less than of doctrine; (6) Banishing from the pulpit the tricks of rhetoric and substituting heart-to-heart hortation to Christian faith and love. The book made a deep impression throughout Germany among the devout laity and the more earnest clergy. Spener was the same year appointed court chaplain at Dresden and in that station was the means of bringing about a reformation of the system of catechetical instruction throughout Saxony. In the Leipzig University some of the students and docents of the theological school formed themselves into a society for study of the Scriptures both intellectual and devotional and those among them who were the more advanced conducted courses of practical exposition and application of the sacred text, to which students and townspeople resorted eagerly, so that the Church authorities were alarmed and the lectures were suppressed by the government. The young theologians thereupon left the university and the city and entered the new university just founded at Halle by friends of the new movement; thereafter Halle was the chief centre of Pietism. Like most other reformatory movements whether in church or state, its aims were from first to last condemned as impious or as seditious, but one by one they were adopted by their antagonists; Pietism as an organized movement subsisted till the middle of the 18th century; its monument was a state church reformed in nearly every particular in accordance with Spener's program. Consult Schubert, ‹Outlines of Church History› (1907).

PIETISTS. See PIETISM; RELIGIOUS SECTS.

PIETRA DURA, pē-ā'trā doo'rā, a mosaic executed in Italy and especially at Florence, in hard stones, such as topazes, garnets, carnelians, rubies, etc. Inferior kinds, in which imitation stones are used, are largely made in England.

PIEZOMETER, any of several instruments for measuring the compression of water and other liquids under pressure. They usually include a glass tube containing a compressible liquid, backed by a graduated gauge, like a thermometer. They are used for testing pressure in water-pipes, the compression of gas in a gun-bore, to discover deep-sea pressures, etc.

PIFFARD, Henry Granger, American physician: b. Piffard, N. Y., 1842; d. 1910. He was educated at the University of the City of New York and in 1864 was graduated at the New York College of Physicians and Surgeons. From 1875 to 1910, Dr. Piffard was professor of dermatology at the University of the City of New York, later known as New York University. He was renowned in the different fields of physics, botany, therapeutics and linguistics. He founded the Dermatological Society, translated Dartrous's ‹Diathesis› (1868) and published several original articles mostly on professional topics.

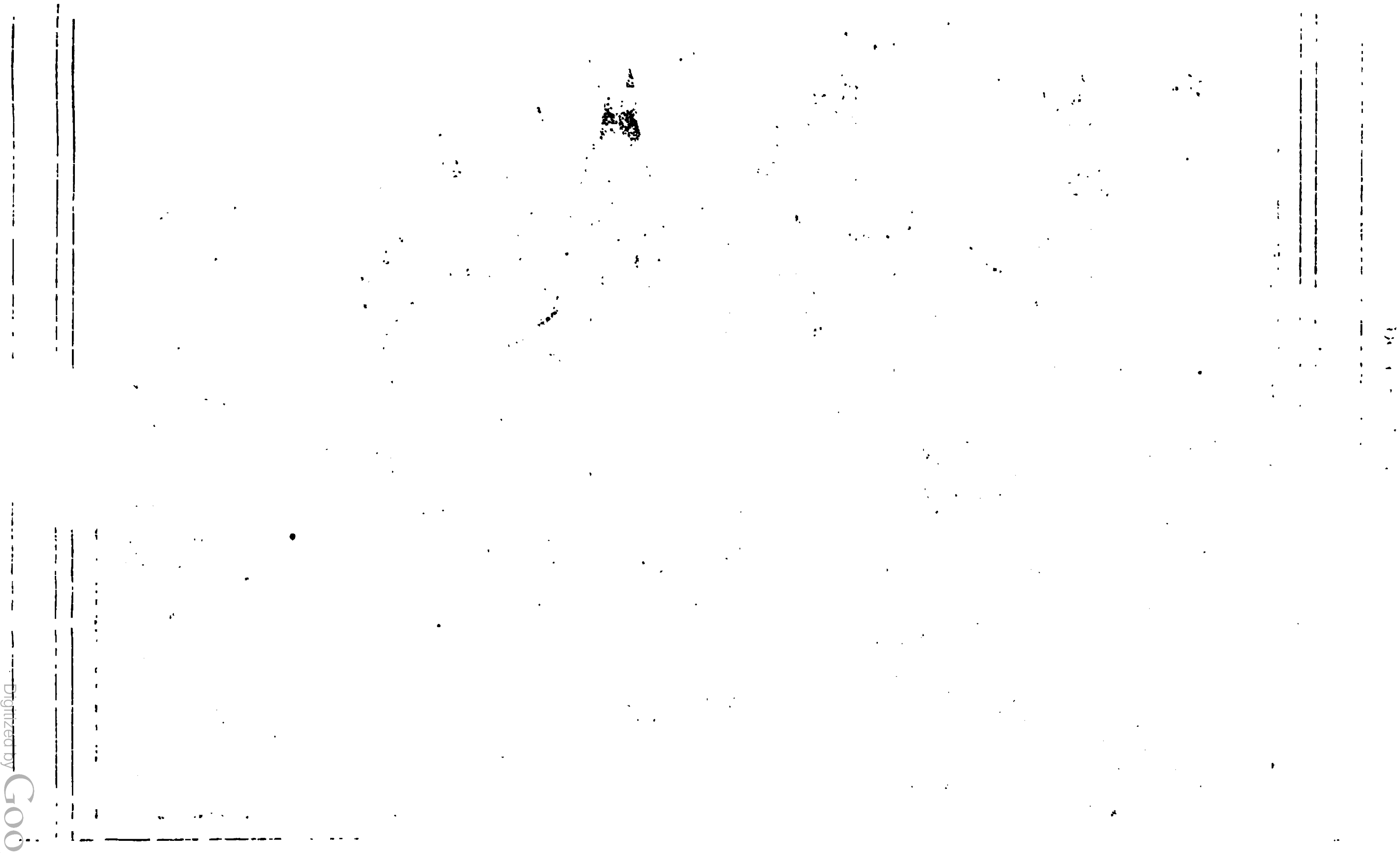
PIG. See SWINE.

PIG-IRON. See IRON AND STEEL INDUSTRY IN AMERICA.

PIGAFETTA, pē-gä-fĕt'tä, **(Francesco) Antonio,** Italian explorer and historian: b. Vicenza, Italy, 1491; d. there, about 1535. He accompanied Magellan on his voyage around the world in 1519–23, and wrote the journal which constitutes the only history of the voyage which remains, as that written by D'Anghiera was destroyed during the storming of Rome in 1527. The first complete edition of this valuable work was published under the title, ‹Primo Viaggio intorno al Globo Terracqueo› (1800).

PIGALLE, pē'gäl, **Jean Baptiste,** French sculptor: b. Paris, 1714; d. 1785. He studied under Robert le Lorrain and Lemoyne, and later at Rome. Pigalle was elected to the Academy in 1744; became professor there in 1752 and rector in 1777. His best work is ‹Mercury Fastening his Sandal,› of which there is a replica in the Metropolitan Museum, New York. Other works are ‹Child with Cage,› ‹Love and Friendship,› busts of Guérin and Maurice of Saxony, all in the Louvre; ‹Mercury› (Berlin Museum); ‹Venus› (Potsdam); Louis XV monument at Rheims; ‹Queen of Heaven,› marble group in Saint Sulpice, Paris; tomb in Notre Dame de Paris; statue of Voltaire in the Institut. Consult Tarbé, ‹La vie et les œuvres de J. B. Pigalle› (Rheims 1859).

PIGEON, a general name applied to any species of bird of the family *Columbidæ*, or collectively to the entire group, or in an even wider sense to the whole order *Columbæ*. No sharp distinction can be drawn between the usage of the words dove and pigeon for birds of this group; though in a general way the former is applied to the smaller and more delicate, the latter to larger and more robust forms. In the articles COLUMBÆ and COLUMBIDÆ will be found some account of the characteristics, distribution and chief groups of the pigeons, and under DOVE descriptions of a few representatives of the smaller wild species. This article will be confined to a discussion of the origin, varieties and care of the domestic pigeons, and a brief account of a few of the native wild species to which the name «pigeon» most properly applies. Accepting the conclusions of Darwin, who investigated the subject extensively, ornithologists and fanciers trace the origin of all the numerous varieties of domestic pigeons to the common rock-pigeon (*Columba livia*) of Europe and North Africa. The ease with which many wild species of pigeons hybridize and produce fertile offspring is, however, well known; and there is much reason to believe that the strain of the domestic pigeons is not entirely pure, but has been mixed from time to time with certain Asiatic species, and especially with such true rock-pigeons as *C. leuconota* and *C. intermedia.* However, all of these forms are very closely related, differing in little besides color; and



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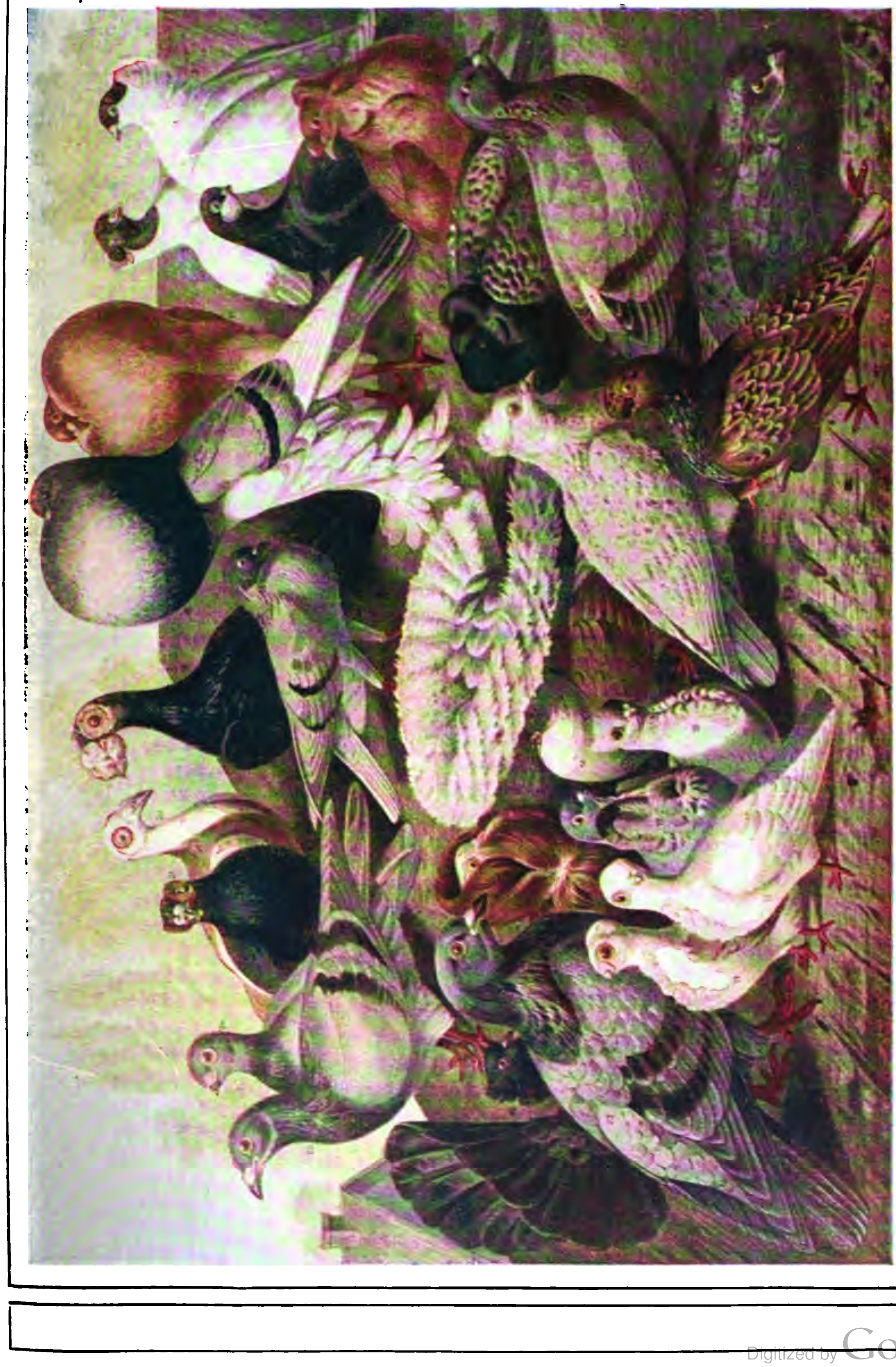
DOMESTIC PIGEONS



1. Bluerock. 2. Drummer-pigeon of Bachara. 3. German Drummer-pigeon. 4. Curly-pigeon. 5. Ruff or Capuchin. 6. German Tumbler. 7. Nun. 8. Almond. 9. Bearded-tumbler. 10. Jacobin. 11. Egyptian Turbit. 12. Chinese Turbit. 13. German Turbit. 14, 15. Fantails. 16. English Pouter. 17. French Pouter. 18. Brown Pouter. 19. Carrier or Homing-pigeon. 20. German Carrier. 21. Cyprian Pigeon. 22. Italian Pigeon. 23, 24. Belgian Carriers.

there is no reason to doubt that *C. livia* is the predominant ancestral species.

Many individuals of the common dovecot pigeon — those of a grayish-blue color with white lower backs and two black wing-bars — very closely resemble the wild rock-pigeon. In the wild state the rock-pigeon inhabits the rocky sea coasts and neighboring islands of Europe and North Africa, but is rare inland; though in many places flocks of domestic pigeons have reverted to the feral state and have reacquired most of the characteristics of their wild ancestors. Indeed several of the so-called species found in various parts of Europe, Asia and Egypt are considered by Darwin to have thus originated. Like their domesticated descendants, wild rock-pigeons are gregarious and live in communities among the caves and fissures of inaccessible cliffs, where they associate with cormorants and other sea-birds. In the early morning they fly in flocks to the cultivated districts for the purpose of feeding upon grains and seeds. They also relish snails, insects and fruits. Except when with young, whose needs force them to return to the nesting site more frequently, they remain in the fields throughout the day. These pigeons are little, if at all, migratory, and during the winter congregate in larger flocks which search the farming districts for food. About April a simple nest of grass and twigs is constructed on a rock-ledge and two eggs are laid. After the young are able to leave the nest a second and perhaps a third pair is raised. They are strictly monogamous, and are said to mate for life. In movements, voice and other ordinary habits they resemble the common domestic pigeon.

Rock-pigeons take very kindly to domestication, and they, and perhaps closely related species, have been confined and bred for an immemorable period, not alone because of the very excellent quality of their flesh as food, but also as carriers of messages, and because of the interest attached to the remarkable and numerous varieties to which they give origin. It is, however, probable that pigeons were first domesticated solely for the purpose of supplying the table; at least the earliest known record, more than 3000 B.C., signifies their use for this purpose by the Egyptians. Several hundred distinctive varieties, of which about 150 are named and recognized by fanciers, have been produced under domestication, some of them differing but little, others to a marvelous degree, from the wild stock; many, indeed, are almost monstrous. Concerning the origin of many of the principal types of domestic pigeons, very little is known historically. Some of them, as the carriers or homing-pigeons, are certainly very ancient, and the Romans, who valued pigeons highly, had many races, the pedigrees of which were carefully recorded. Darwin based his conclusion that all this multitude of divergent forms could be traced back to a common ancestry in the rock-pigeon not only on the well-known facts of the ease with which the rock-pigeon can be domesticated, the resemblance in appearance, habits and voice between the common domestic pigeon and the wild rock-dove, and the geographical distribution of the latter, but also upon a most painstaking anatomical study of many varieties and of the facts of breeding and reversion. He noticed that triple crosses between distinct varieties of no matter what color were very likely to produce in the third generation a color pattern precisely like that of the wild race. The remarkable persistence of the white wings, which breeders find to be one of the most difficult features to breed out of fancy-colored strains, points to *C. livia*, of which this feature is a characteristic. Darwin's views have been generally accepted, as has his classification of the numerous varieties. Four principal groups are recognized: (1) The pouters, forming a very distinct race especially characterized by the enormously enlarged inflatable œsophagus and crop; (2) a group in which the beak is generally long (short in the barbs), the skin about the eyes and the base of the beak is rough, swollen and wattled, and the feet are large; in this group are included the various kinds of carriers, dragons, runts and barbs; (3) a group in which the beak is short and the naked skin about the eyes but little developed; Darwin considers this an artificial group and includes in it the fantails, owls and turbits, tumblers, frill-backs and jacobins, each representing a well-marked sub-group; (4) this group includes a great number of races more or less closely resembling the rock-pigeon, from which they have departed much less widely, and are consequently less highly valued by fanciers than the more strikingly modified races of the preceding groups. Among those which Darwin considers as belonging here are the trumpeters, laughers, nuns, spots, swallows and common dovecot pigeons, of which the latter stands nearest to the ancestral type. Next to the pouter the fantail is the most extreme modification, for its tail contains up to 36 or even 42 quill feathers, in place of the 12 originally present.

Concerning the care of pigeons a few general principles may be stated and the novice will avoid many difficulties by recalling the habits of the wild birds and not running counter to nature. In domestication a dovecote or loft is substituted for the rocky caverns of their native isles, but pigeons should have as much freedom as possible, with plenty of fresh air, light, clean food and water, and a clean and roomy shelter from the extremes of weather. Dirty, crowded quarters engender parasites; sour food and lack of air and light cause various diseases; lack of suitable shelter from the weather proves especially fatal to the young birds and nestlings. If possible, pigeons should be given the utmost freedom to fly and return at will; but, if for any reason this is inexpedient, a large flying-cage in the open air should be provided. The gregarious instinct is so strong in pigeons that birds continually desert a small flock in order to join a large one in the same neighborhood. For housing pigeons the loft is preferable to the cot or small house, for very many reasons. It should be a large, airy, well-lighted room, with suitable means for the ingress and egress of the pigeons, and capable of being divided in order to permit of the separation of the different races and sexes when desired. Easily cleaned nesting and roosting boxes may be arranged in shelves on the walls and during the breeding period should be provided with nesting saucers or pans, some clean, soft hay, and kept scrupulously clean. Pigeons do not dust, but are very fond of bathing, for which ample facilities should always be provided. The food best adapted to the hardier is not always suitable to the more delicate varieties, which require a more dainty diet; but in general crushed Indian corn, wheat, peas and beans are the staples, the legumes especially for breeding birds. If they have no opportunity to fly in search of insects and snails a few of these or of earthworms should be occasionally added. A little salt, an abundance of ground oyster-shells or other calcareous material, gravel and drinking water are required. For the special requirements of the fancy varieties reference must be made to some of the special works on pigeon breeding.

Besides the fancy varieties raised in the United States, great numbers of the common sorts are bred for use at shooting-matches and for table consumption in the form of squabs. Most of the supply comes from the small lofts owned by numerous farmers and stablemen, but in a few places the business has been entered upon on a more extensive scale.

Besides many species known as doves, four species popularly designated as pigeons occur in the United States. Three of these belong to the typical genus *Columba*, to which the rock-pigeon belongs. These are the band-tailed pigeon (*C. fasciata*) of the Rocky Mountain and Pacific region, with a distinct sub-species in Lower California; the red-billed pigeon (*C. flavirostus*) from Arizona southward, and the white-crowned pigeon (*C. leucocephala*) of Florida and the West Indies. They all differ greatly from the rock-pigeon in habits, being wood-pigeons, which build their nests in trees and bushes, among whose branches they largely live, though they feed upon the ground on acorns, nuts, seeds, etc. They lay two eggs, like most pigeons, and are gregarious, the first especially often collecting in great flocks. From all of these the famous passenger pigeon (*Ectopistes migratorius*) is distinguishable at a glance by its long tail composed of 12 slender, tapering feathers. It is a large bird, having a total length of 16 to 18 inches, and, with its graceful form and beautiful metallic tints, is a bird of impressive appearance. This bird has no fixed abode, but wanders widely in great flocks in search of food. Formerly it ranged throughout North America east of the Rocky Mountains and occasionally pushed even to the shores of the Pacific. It was most abundant, however, east of the Great Plains and in temperate regions. At the present time it has practically disappeared from most of this region and is now found in any numbers only in the upper Mississippi Valley and the borderland between the United States and Canada. See PASSENGER PIGEON; HOMING PIGEONS, and the names of various groups and species.

Consult Darwin, C., 'Animals and Plants under Domestication' (2 vols., New York 1900); id., 'Origin of Species by Means of Natural Selection' (6th ed., New York 1906); Evans, A. H., «Birds,» in 'Cambridge Natural History' (Vol. IX, New York 1900); Fulton, R., *editor*, Wright, L., 'Illustrated Book of Pigeons' (New York 1876); Howard, G. E., 'The Homing Pigeon' (Washington 1901); MacCleod, A., 'Pigeon Raising' (New York 1913); Mershon, W. B., *editor*, 'The Passenger Pigeon' (New York 1907); Rice, E. C., 'The National Standard Squab Book' (Boston 1914); Stewart-Baker, 'Indian Pigeons and Doves' (London 1913); Tegetmeier, W. B., 'Pigeons: Their Structure, Varieties, Habits and Management' (London 1868); Twombley, E. G., 'The Pigeon Standard' (Boston 1900).

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PIGEON-BERRY, or INK-BERRY. See POKEWEED.

PIGEON ENGLISH. See PIDGIN.

PIGEON HAWK, a small falcon (*Falco columbarius*), distributed throughout the northern hemisphere. There are more than a dozen species scattered over the world, the two most common being the European representatives Hobby and Merlin; they prefer wooded cultivated districts, and usually follow in the train of the small migratory birds on which they prey; the flight is rapid and long sustained; the nest is made on trees or among rocks, and the eggs are from three to five. The American pigeon hawk is 12 to 14 inches long and about 25 in alar extent; the male smaller. The general color is bluish slate, every feather with a longitudinal black line; forehead and throat white; below pale yellowish or reddish white, each feather with a longitudinal line of brownish black; the tibiæ are light ferruginous, with black lines; quills black, with ashy white tips; tail light bluish ash, tipped with white, with a wide subterminal black band and several narrower bands of the same; cere and legs yellow and bill bluish; the variations in plumage, according to age and locality, are considerable. It is found over all temperate North America, Central and the northern part of South America, and breeds in the north. It is the boldest of any hawk of its size, pouncing on thrushes, wild pigeons, woodpeckers, snipe and even teals, but preying chiefly on birds of the size of the red-winged blackbird and sora rail. It rarely attacks poultry, yet has been known to seize cage-birds hung in the porches of houses even in crowded cities. The nest, placed in some thickly foliaged tree, is coarsely constructed of sticks and mosses, resembling that of a crow; the eggs measure about one and three-fourths by one and one-half inches, and are nearly spherical; the color is not a very clear white, and there are a few bold irregular dashes of light yellowish brown, chiefly about the smaller end.

The pigeon hawk, says Stejneger, is very closely allied to, if not identical with, the European merlin (*F. lithofalco*); these two forms, with the East Indian turumti (*F. chiquera*), and its South African race (*F. ruficollis*), are frequently regarded as a separate genus *Æsalon*. Consult Fisher, A. K., 'Hawks and Owls of the United States' (Washington 1893).

PIGEON-PEA, the fruit of the leguminous shrub *Cajanus indicus*, a native of India, but now cultivated in tropical Africa and the West Indies. There are two varieties, distinguished as *bicolor* and *flavus*. The former reaches a height of from three to six feet, and has yellow flowers with crimson markings; the latter is larger, sometimes attaining a height of 10 feet, and its flowers are of a uniform yellow color. In India the pigeon-pea forms a pulse of general use. The former variety is called also Angola pea and Kongo pea.

PIGEON SHOOTING. See TRAP-SHOOTING.

PIGEON WOODPECKER, the flicker. See Woodpecker.

PIGEONS, Clay. See Trap-shooting.

PIGLHEIN, pēg'l-hin, **Bruno,** German painter: b. Hamburg, 19 Feb. 1848; d. Munich, 15 July 1894. He began his study of painting in the studio of Lippelt in Hamburg. Going to Dresden in 1864 he attached himself to Schilling, with the idea of becoming a sculptor, but in 1870 returned to painting, which he studied under Pauwels in Weimar, and in Munich under W. Diez. The series of decorative works and mythological genres which he soon afterward produced show the influence of Böcklin (q.v.) and Makart. He first became widely known by his 'Moritur in Deo' (the dying Christ supported by an angel), now in the Berlin National Gallery. He then executed a series of drawings in pastel,— busts, heads and half-lengths of ladies of fashion, rakes, dandies and children,— which appeared at Munich (1884) under the title 'Douze Pastels.' His genre pictures of child life are well known through the reproductions of his illustrations to the idyll 'Kind mit Hund.' In 1885 he undertook a journey to Palestine with the object of collecting materials for a panorama of 'the Crucifixion,' which he completed with the assistance of several other artists and exhibited in 1886. It was afterward reproduced in wood cuts 1887, but the original was destroyed by fire at Vienna (1892).

PIGMENT (old French), any substance that is used or can be used by painters. The word comes indirectly from the Latin *pigmentum,* and is related to paint and painting. The Picts of Scotland were so called because they painted themselves. Technically a pigment is a dry substance that can be easily pulverized if it be not already in the form of powder. But the term has been extended so as to include mixed paint ready to be applied.

In biology the word pigment is used in the sense of organic coloring matter; that is organized substances in the tissues of animals and plants giving them color. This coloring matter or pigment is very generally distributed throughout the animal and plant kingdoms, the absence of color in any of them or of their parts being very rare. The darker or lighter color of the skin in different races is due to the presence of more or less heavy pigmentation of the choroid. In many plants and animals the pigment color characterizes the genera, or family. This is especially noticeable in the lower forms of animal and plant life.

A highly spiced wine sweetened with honey is also called pigment. See Color.

PIGMENTS, Animal. See Coloration, Protective.

PIGMY. See Pygmies.

PIGNUTS. See Hickory.

PIGOT, Sir **Robert,** British soldier: b. Patshull, Staffordshire, 1720; d. there, 2 Aug. 1796. Entering the army as a boy, he served at Fontenoy, was colonel in 1772, accompanied the 38th foot to Massachusetts, fought at Lexington, 19 April 1775, and 17 June commanded the British left at Bunker Hill, becoming colonel of the regiment in December of the same year and major-general in 1777. He was stationed in Rhode Island in the next year, and in 1782 became lieutenant-general. In 1778 he succeeded his brother as baronet and became part owner of the Pigot diamond, brought by his brother from India; it was raffled for in 1800, the receipts being nearly $120,000 and in 1802 was sold for $150,000 to Ali Pasha, who had it ground to powder in 1822, when he was mortally wounded by Reshid Pasha.

PIGRIS, a Greek poet, brother of Artemisia, queen of Caria (352–350 B.C.). Modern critics assign to him the authorship of the famous mock epic, *Βατραχομυομαχια,* 'The Battle of the Frogs and Mice,' a work formerly accredited to Homer.

PIGWEED. See Goosefoot.

PIKA, a small animal of the higher mountains of the northern hemisphere, representing the family *Lagomyidæ,* and closely allied to the hares, of which it seems a degenerate branch. The pikas differ from the hares in their much smaller size, in the nearly equal length of the fore and hind legs, in the short, rounded ears, the very small size or absence of the tail, and in the possession of nearly complete clavicles or collar-bones. In their most southern distribution they inhabit the mountainous districts and highlands, well-known species being numerous on the mountain tops of the European Alps, in the Himalayas and in the Rocky Mountains. They are never seen below timber-line, but are found far above it, in Ladak to the altitude of 16,000 feet. They dwell in underground burrows, or among the loose fallen rocks of a slide or cliff-talus, where large communities occupy favorable places. To this they owe the name «coney,» commonly given to *Lagomus princeps,* the best-known American species, which the Indians called «little chief.» The European name, «calling» or «piping» hare, refers to the shrill, piping bark. They feed upon herbage during the summer, and in the early autumn cut and dry a great quantity of this, which they take into their deep burrows as provender for the winter. Their fur is exceedingly warm and close, and was utilized by the American Indians as material for underclothing, infants' garments, etc. About 16 species are known. Consult Blanford, 'Fauna of British India Mammals' (1888); Stone and Cram, 'American Mammals' (1902).

PIKE, Albert, American author and lawyer: b. Boston, Mass., 29 Dec. 1809; d. Washington, D. C., 2 April 1891. He was educated at Harvard, engaged in teaching, in 1831 accompanied an expedition to Santa Fé, afterward exploring the head-waters of the Red and Brazos rivers, and in December 1832 settled at Fort Smith, Ark. He edited the Arkansas *Advocate* in 1833–36, was admitted to the bar and engaged in law practice. In the Mexican War he commanded a squadron, fought at Buena Vista, received the surrender of Mapimi in 1847, and during the Civil War was Indian commissioner of the Confederate government, and later brigadier-general. After the war he practised in Memphis and in Washington, edited the Memphis *Appeal* in 1867–68, and engaged in literary work. His 'Hymns to the Gods,' published in *Blackwood's Magazine* in 1839, gained for him a reputation as a poet, and besides 30 volumes of Masonic works he published 'Prose Sketches and Poems' (1834).

PIKE, Robert, English colonist in America: b. England, 1616; d. Salisbury, Mass., 1706. He came to America in 1625, from 1629 resided on a farm at Salisbury, Mass., and from 1644 until his death held public office in a colony. He is distinguished for his liberal attitude on various questions of colonial interest. Thus, though a believer in witchcraft, he opposed the admission in court of «spectre» testimony; and though a strictly orthodox Puritan, defended the Quakers, and censured the general court for its position in the matter. In these questions he appears as one of the earliest exponents in America of the sentiment toward free speech, criticism, and petition of legislative assemblies, and acquittal in courts of law in default of sufficiently conclusive evidence.

PIKE, Zebulon Montgomery, American soldier and explorer: b. Lamberton, N. J., 5 Feb. 1779; d. York (Toronto), Canada, 27 April 1813. He was the son of an army officer, into whose company he volunteered, serving as a cadet when only 15, and becoming a first lieutenant six years later. In 1805 after the Louisiana Purchase he was ordered to trace the upper course of the Missouri, and with 20 men spent nearly nine months on the dangerous voyage to Red Cedar Lake. Immediately upon his return he was commissioned by General Wilkinson to lead a party through the centre of the Purchase. This expedition was overtaken by winter and the party, while on the banks of what they thought the Red River, was arrested by the Spanish authorities, who later released all members of the expedition. Before his arrest Pike had discovered «Pikes Peak» and had explored the country around Leadville. He arrived at Natchitoches 1 July 1807, was warmly thanked by his superiors, and was rapidly promoted. In 1812 he was stationed on the frontier, and in the next year, having become a brigadier, led the attack on York, Canada. The magazine of the fort exploded during the assault and Pike was killed by a flying stone. The fort surrendered just before he died. Consult Cones, E., 'Expedition of Zebulon M. Pike to the Headwaters of the Mississippi' (3 vols., New York 1895).

PIKE, a weapon much used in the Middle Ages as an arm for infantry or foot-soldiers. It was from 16 to 18 feet long, and consisted of a pole with an iron point. (See LANCE). Men armed with it were called pike-men. After the invention of guns, pikes gradually fell into disuse, the bayonet in the musket or rifle being more suited to hand-to-hand fighting. The Prussian Landsturm was armed with pikes in 1813, to be used in case no better arms were to he had. The Swiss first substituted the halbert for the pike toward the 15th century. For some time every company in the armies of Europe consisted of at least two-thirds pikemen. In the United States during the John Brown (q.v.) insurrection at Harper's Ferry, Va., Brown's followers were armed with pikes as well as muskets.

PIKE, PICKEREL, fresh-water, ravenous fishes of the family *Luciidæ* or *Esocidæ*. They are teleostomous fishes, forming, with the mud-minnows, cyprinodonts and blind fishes, the order *Haplomi*. In the pikes the body is lengthened, flattened on the back, and tapers abruptly toward the tail. One dorsal fin exists, placed far back on the body, and opposite the anal fin. The mouth is very large and lower jaw projects, the biting edge of the upper jaw being formed by the maxillary and premaxillary bones. Teeth are present in plentiful array, and are borne by almost every bone entering into the composition of the mouth as well as small ones upon the tongue. They are very sharp and of various sizes, the larger ones having a hinge-like attachment by means of a ligament, to the bones. The body is clothed with small cycloid scales, or those of a simple rounded variety. There is a single genus (*Lucius*) with five species, four of which are confined to North America, the fifth being found in Europe and Asia also. The common pike (*Lucius lucius*) occurs in the rivers of Europe, northern Asia and North America. Pikes are the tyrants of their sphere, being the most voracious of fresh-water fishes. They feed upon smaller fishes, upon frogs, muskrats, and other animals; and young ducks and other aquatic birds have been known to be dragged below the water and devoured by these fishes. Perches and sunfish are said to escape the pike's attack owing to the presence of their spiny dorsal fins. When fully grown the pike may ordinarily attain a length of four feet, and there are instances on record in which these fishes have exceeded that length.

In America this species ranges from the Ohio River and southern New York to Alaska and Greenland, and is especially abundant in the lakes and rivers of British America. It prefers quiet waters; and remains for long periods suspended perfectly stationary in the water, but, when its prey approaches, darts upon it with the utmost suddenness and the speed of an arrow. Throughout the year, except in the spring when they consort in pairs, the pike leads a solitary life; 100,000 to 500,000 eggs are deposited from April to May, according to the latitude. No nest is made, and the non-adhesive eggs sink to the bottom. The muskellonge or muscalonge is a still larger species, often attaining a length of five to eight feet and a weight of 100 pounds or more. It may be quickly distinguished from the pike, with which it is often confused, by the absence of scales from the lower part of the cheeks and the greater number of rays in the fins. It is found in the Great Lakes and other large bodies of water in that general region and northward. Being a pike on a large scale, its habits closely resemble those just described for that species. It prefers the deeper waters, resting among plants near the bottom and is a most formidable enemy of all living creatures inhabiting the same waters.

The name «pickerel» is the diminutive of pike and is employed to designate all of the small species as well as the young of the larger. The species to which this name is especially applied are the banded pickerel (*L. americanus*), which seldom exceeds 12 inches, and is found in lowland streams of the Atlantic watershed from New England to Florida; the western pickered (*L. vermiculatus*), a similar species of the Mississippi Valley; and the common pickerel, pike, or jack (*L. reticulatus*) of the entire eastern United States. The last named attains a length of two feet and is common everywhere, being especially abundant in clear lakes, where it reaches the largest size.

All of these are most excellent table fishes. The dash with which they take the hook, and the vigor and determination with which they fight for liberty makes them great favorites with sportsmen, though their destructiveness to other game fishes has gained them many enemies. The larger species, and especially the muskellonge, are usually taken by trolling, a copper wire line being used when they seek the depths of the lakes. The smaller ones may be taken with a light tackle, the chief precaution being to provide against the severance of the line by their sharp teeth. Live minnows or small frogs are tempting baits.

The name pike is also used for several other quite unrelated fishes which present some resemblance to the pikes in their elongated forms. Among these may be mentioned the gar pikes (*Lepidosteus*) and the sea pike or silver gar (*Tylosurus*). Consult Henshall, 'Bass, Pike, Perch and Others' (New York 1903); and Cholmondeley-Pennell, 'Book of the Pike' (New York 1890).

PIKE-PERCH, a fish closely allied to the perch, but showing a resemblance to the pike in the elongated body and head. The American pike-perches belong to the genus *Stizostedion,* which differs from the European *Lucioperca* in the weaker development of the fin spines. From the true perches the pike-perches are easily distinguished by the elongated head and the presence of canine teeth on the jaws. The most important species is *S. vitreum,* which bears a large number of local names, but is best known as the wall-eyed pike (q.v.). The chief European species is *L. sandra,* which attains a length of three or four feet, and weighs 25 or 30 pounds. The *S. canadense* inhabits many of the northern lakes of North America, and is slightly more cylindrical than *S. vitreum,* besides having more spots on the fins and no black spots back of the dorsal fins.

PIKES PEAK, in Colorado, a peak of the Rocky Mountains, lat. 39° N., long. 105° W.; the height is 14,108 feet above sea-level. Gen. Z. M. Pike, of the United States army, discovered this mountain in 1806. Colorado Springs, a famous summer resort, is near by. In ascending the mountain the transition is abrupt from pine forests, which cover the sides up to nearly 12,000 feet in height, to bare granite rocks with here and there tufts of sage grass in the crevices and at the summit, fringing the snow fields, plants with pale yellow and delicate purple blossoms. Two gorges extend from the top almost to the base. The summit is nearly level, with an area of about 60 acres. From the top may be seen a view of unsurpassed magnificence and grandeur; for fully 100 miles in all directions is a vast expanse of mountains and valleys, dotted with sparkling lakes and rivers. From 1873 to 1888 the United States Signal Service had here a meteorological station. The weather bureau established a station here in 1892. In 1891 a rack and pinion road was opened to the summit. The name Pikes Peak is often applied to the gold region in the vicinity of the mountain.

PILASTER, *in architecture,* a column set in and partially projecting from a wall, as an ornamental support to an arch, etc., and seldom projecting more than one-fourth or one-third of its breadth from the wall. It may be a simple square support, or of any of the common orders of architecture, with capital.

PILATE, pī'lạt, **Pontius** (PONTIUS PILATUS), the Roman governor (procurator) of Judæa, Samaria and Idumea at the time of Christ's crucifixion: he held that station from the year 26 till he was deprived of office in 36: the capital of the district ruled by him was Cæsarea, in earlier times known as Turris Stratonis. Little or nothing is known regarding his history previous to his appointment as procurator. He was a man specially unfitted by temperament for the station to which he was assigned, in view of the keen animosities existing for ages between the Jews, the Samaritans and the ancient inhabitants of Philistia, and the abhorrence of the Jews for their Gentile rulers. Pilate flaunted in the face of the people of the Holy City the standards of the Roman armies with the image of Tiberius and the eagles of the legions, both of which were always saluted with religious veneration as gods; he rifled the sacred treasury (*corban*) of the temple to pay the cost of an aqueduct; he slaughtered a company of Galileans while they were engaged in an act of sacrifice; he set his troops upon a peaceable assemblage of Samaritans on Mount Gerizim, the holy place of that nation; it was this act, not his surrendering Jesus into the hands of his enemies in violation of Roman justice and simple humanity, that led to his being deprived of office. Eusebius adds that he was banished to Vienna (Vienne) in Gaul and that he died by suicide. But legend does not treat his story so prosaically; one legend makes him die at Rome where his body, having been thrown into the Tiber, caused violent tempests and inundations; but the patrons of the Vienne tradition make Vienne and the river Rhone the theatre of these prodigies. Strangely, Tertullian holds Pilate to have been at heart a Christian (*pro sua conscientia christianus*); the Copts reckon him among the martyrs, and he has a place in the Abyssinian Church calendar. Pilate's wife, traditionally named Procla, or Claudia Procula, is venerated in the Greek Church as a saint; her day in the Greek Church calendar is 27 October. Consult the apocryphal 'Acts of Pilate'; Rosadi, G., 'The Trial of Jesus' (London 1905).

PILATUS, pē-lä'toos, **Mount,** in Switzerland, a peak of the Bernese Alps, near Lake Lucerne. The highest crest, Tomlishorn, is 6,998 feet above sea-level. A rack and pinion railroad extends to the summit. The name seems to have come from the word *pila,* a pillar, hence, "pillar mountain." Some authorities claim the name comes from *mons pileatus,* "hatted mountain," from its appearance when the mists or clouds are rising. One of the numerous legends connected with the place is that it is named after Pontius Pilate, who from the top of this mountain threw himself into a lake and was drowned. Allusion is made to this legend in Scott's work, 'Anne of Geierstein.'

PILAU, pĭ-lä', or **PILLAF,** a food preparation common in Turkey, Egypt, Syria and India, consisting generally of rice, thoroughly boiled, drained, and gently stirred with butter, pepper and finely-chopped onions. For the tables of the wealthy, fowls, lamb, mutton, shreds of ham or bacon, variously cooked, but always well boiled or roasted, are placed on the top of the rice, and served with it.

PILCHARD, a European herring (*Clupea pilchardus*), the full-grown form of the sardine (q.v.), which closely resembles the ordinary herring but is of smaller size and straighter outlines. This species is found in greatest plenty on the southern coasts of England, the Cornwall pilchard fisheries being those best known and most celebrated. The fishery is more or less continuously carried on, but proceeds with the greatest vigor in July. Shoals of pilchards then appear, which are taken in seines in vast amounts. More than 10,000 hogsheads, each holding 3,000 fish, have been filled in a single day's fishing at one port. These fishes are salted and cured, and are then piled into great stacks, from which a valued oil exudes. They remain four weeks in these stacks, and are then washed to free them from the oil, packed in barrels, and afterward exported. The pilchards are chiefly consumed in Spain, Italy and France during Lent and other fasting seasons.

PILCOMAYO, pēl-kō-mī'ō, a South American river, one of the affluents of the Paraguay, rising in the Bolivian pleateau east of the Andes from several small streams in the provinces of Lipez, Chichas and Poopo. Its general course is southeast, and its length perhaps 1,300 miles. It receives the Potosi and the Cachimayo; crosses the department of Potosi, Sucre and Tarija; joins the Pilaya, which drains southern Bolivia, above San Francisco Solano; and near that mission is joined by the Chaco. Its course so far is narrow, winding, and full of rapids and cascades, and its drop has been from a height above the sea of 6,500 feet to only 1,300 feet. But on coming into the flat country it does not become a navigable river, but like many of the Western rivers of the United States almost disappears in the sands and then spreads out in shallow lagoons, so that the embouchure of its main branch into the Paraguay is a forest swimming in a lake delta. Other branches join the Paraguay farther south than Asuncion, where the main branch empties. The main branch was a subject of dispute between Argentina and Paraguay, as the boundary was defined simply as being the main branch of this river. The Spanish explorers had considered it to be the Araguai Guazu (or Rio del Instituto Argentino); but a board of arbitration of which Rutherford B. Hayes was president decided against this claim in 1878. Fishing in the river is excellent. Exploration was begun by Father Patino in 1721. In 1882 Crevaux, a French explorer, was killed with five of his comrades by the Toba Indians.

PILE, or **SPILE,** in engineering and building, a heavy beam or timber, driven into soft ground, sand, mud, etc., to form part of a solid foundation for a building, wharf, wall, etc. The word comes from Anglo-Saxon *pil*, a sharp stake, which is also represented in modern English by the word *pale*, as a fence-pale. A pile is usually a portion of a straight tree trunk, from six to eight inches diameter at the smaller end, which is sharpened to a point, to drive easily into the ground. Sometimes this point is armed or protected with iron or steel, to prevent the wood from splitting in going down into hard ground. A pile may be of any length that can be conveniently handled, but from 20 to 60 feet is the usual thing. A series of them driven into a muddy bottom on a shore make a very firm support for a building. As wood becomes scarcer, the concrete pile has come into use, being a light shell of steel, filled with concrete. In some instances, as for steadying the tubes of the Pennsylvania railway tubes under the Hudson River, screw piles have been preferred, these having a very broad screw-like flange at the foot, which resists motion in any direction. They are put into position by turning like a screw, whereas the common pile is driven by a pile-driver. See FOUNDATION.

PILE, a primitive form of electric battery, made of plates piled up, as a dry pile, voltaic pile or thermopile. See ELECTRICITY.

PILE-DRIVER, a machine for driving piles or spiles. A tall framework carries a heavy weight sliding between guides and confined by a rope. The pile being adjusted in position, the weight is dropped on the head of the pile, thus hammering it down, until the desired level is attained. A hoisting engine may be employed to raise the weight, and it may be given added force for its blow by a steam piston, on the principle of a steam hammer.

PILE-DRIVING. See FOUNDATION.

PILE-DWELLINGS, See LAKE-DWELLINGS.

PILES. See HEMORRHOIDS.

PILEWORT, a plant regarded as curative of piles. In Great Britain these virtues and the name belong to the celandines (q.v.), especially *Chelidonium majus*. In the United States several herbs of medicinal repute are called pileworts, such as the Maryland figwort (*Scrophularia marylandica*); the fire-weed (*Erechtites hieracifolia*), a thistle; and a crowfoot, the so-called lesser celandine (*Ficaria ficaria*).

PILGRIM, Charles W., American physician: b. Monroe, Orange County, 1860. He received his medical degree from New York University in 1881 and pursued his studies further at the University of Vienna. In 1882 he was assistant physician in the asylum for insane criminals at Auburn, and occupied a similar position later at the Utica State Hospital and at the Women's Hospital at Munich, Germany. In 1890 he was appointed superintendent of the Willard State Hospital, and three years later became head of the Hudson River State Hospital. In 1906 he became president of the State commission in lunacy, which office he resigned in the following year to resume his work at the State hospital. In 1916 he was appointed chairman of the State hospital commission under Governor Whitman's régime.

PILGRIM COMPACT, The. See MAYFLOWER, THE.

PILGRIM FATHERS. See MAYFLOWER, THE.

PILGRIMAGE OF GRACE, in English history, an insurrectionary movement in 1536–37, consequent upon the proceedings of Henry VIII in regard to the Church, and led in the first instance by Robert Aske, a Lincolnshire gentleman. The insurgents demanded the fall of Cromwell, redress to the Church, and reunion with Rome. Mustering to the number of 30,000, they marched upon York, and within a few days were masters of England north of the Humber. Henry temporized, promising a free parliament at York; but when the insurgents returned home all concessions were revoked, and a renewal of the revolt was suppressed with great rigor. Many perished by the block, the gibbet and the stake. See ENGLAND.

PILGRIMAGES, journeys to distant places for devotional purposes. The custom of pilgrimage is ancient and, until modern times, was universal. In ancient Egypt and Syria were privileged temples to which devotees resorted from distant parts. Pilgrimage is an important element in the religions of India. In the period of highest Grecian culture, whether in Greece itself or in Asia Minor or in Magna Græcia, the chief temples of the Hellenic gods were the resort of pilgrims in thousands; the temple of Athenē at her own city, that of Zeus at Olympus, that of Æsculapius at Epidaurus, of Hera at Samos, of Artemis at Ephesus, were for the Greeks what the temple at Jerusalem was for the people of Israel, or what Mohammed's tomb is for the Moslems. «We are only stirred,» says Cicero, «by the very places that bear the footprints of those we love or admire.» The pilgrimages of the Jews to their holy city at the high festivals were matter of precept; in Christianity, though pilgrimages have never been commanded by the Church, the custom of pilgrimage has had a vast development, beginning probably in the first Christian Age, and certainly attaining considerable proportions in the century which saw the triumph of the new religion over Roman paganism. Among the works of Saint Jerome (340–420) occur letters of his correspondents in Syria, the ladies Paula and Eustochium, in one of which the resort of numerous pilgrims to the holy places in Palestine is recorded in terms which give proof that in that day pilgrimage was a highly esteemed form of devotion, though the historical accuracy of the statement that pilgrims had flocked to the scenes of Christ's life «ever since the ascension» is open to question. «It were irksome,» the lady Paula writes, «to count the bishops, the martyrs, the masters of ecclesiastical learning, who from the Lord's ascension till this day have come to Jerusalem, thinking that they would have less devotion, less knowledge; that their virtues would lack their last perfection, unless they should have worshipped Christ at the very spot where first the gospel light beamed forth from the gibbet.» We learn from Saint Augustine and some of his contemporaries that the tomb of the protomartyr, Saint Stephen, attracted in his time great throngs of pilgrims. But it was in the Middle Ages that pilgrimage had greatest vogue. For some time after the Saracens had become masters of Palestine the pilgrims from the West had unhindered access to the holy places; but when Jerusalem came under the control of the fanatical sect of the Fatimites, Christian devotees were made the victims of all forms of outrage. After enduring this for about two centuries the Western world poured out its hosts of armed pilgrims, the Crusaders. But Palestine did not comprise all the places of pilgrim resort: near the city of Rome is Loreto, believed to contain the very house in which Jesus and his mother lived; Spain had the shrine of Saint James (Santiago) de Compostella; France that of Saint Martin of Tours. In the year 1428 there sailed from nine different ports of England for Spain on the way to Compostella 866 pilgrims; at the same time there were several famous shrines in England itself, chief among them the shrine of Saint Thomas á Becket, archbishop of Canterbury, one of the most celebrated resorts of pilgrims. In the latter half of the 19th century there was a revival of the custom of pilgrimages, especially in France. The most persistent pilgrimages of modern times are those of Islamites to Mecca (q.v.) and Medina (q.v.). These two Arabian cities live almost wholly off the pilgrims who come in vast numbers. Mecca is the sacred city, but the bones of the Prophet lie in a mosque at Medina, so thousands of the faithful deem it incumbent on them to visit both cities.

PILGRIM'S PROGRESS, The. This is an allegory of the life of man, the journey of the awakened soul to God. Crying «What shall I do?» Christian flees from the City of Destruction, puts aside his jeering or pitying neighbors, struggles through the Slough of Despond, trembles under Sinai, is comforted and instructed at Interpreter's house, and losing his burden at the Cross, is ready for the great journey. He fights against Apollyon, is imprisoned with Faithful in Vanity Fair. Escaping both seducers by the way and the clutches of Giant Despair, he gains those Delectable Mountains whence, though Atheist and Ignorance intervene, the way to the Celestial City is sure, even through the river of Death. Though the conception of human life as a hard journey toward the divine is both old and common, it has nowhere else been imagined so appealingly. This is not critical opinion; it is fact. The 'Pilgrim's Progress,' translated into all languages, has had a circulation beyond the possibility of record. It is one of the few instances, not merely of international fame, but of international popularity. Its characters have become proverbial; and the Slough of Despond and Vanity Fair are used almost as common nouns.

Popularity so wide must have its springs very deep. Surface reasons explain merely the occasion. Bunyan was a Dissenter in the time of the Protestant revolt. Born eight years after the Pilgrims landed at Plymouth Rock, he was a lad during the Civil War (1642–46), a young man under the Commonwealth and in his manhood 12 years a prisoner for insisting on liberty of preaching. He spoke to English Protestants on both sides of the Atlantic in their own religious language. But since his appeal has been limited neither to English nor to Protestants, we must look deeper. The persons of the 'Pilgrim's Progress,' Mr. By-Ends, the brisk lad Ignorance, Faithful and the rest, though they bear abstract names, are not mere personifications. They are more than the types of ordinary allegory, more even than the picturesque figures of the 'Faery Queene.' They are individuals, as truly characters as the persons of plays and novels. They talk as real people. We get from them what we desire of all imaginative literature, vicarious experience of human life.

The life that Bunyan thus creates by force of imagination he knew by direct contact. It is common life because he was a man of the people. An unschooled tinker, mending pots and pans from door to door, he knew the common hopes and loves and fears by daily hard experience from childhood. That tells why he speaks the common language, a language so common as to be sometimes illiterate; it does not yet tell why he speaks the universal language. Bunyan happened to be a tinker; he was born to be a preacher; he became a great preacher because he developed to an extraordinary degree imaginative vision. Such of his actual sermonizing as has been imperfectly preserved, or is suffered to interrupt the story of the ‹Pilgrim's Progress,› shows little beyond the disputatious habit of his sect. It is not characteristic. Bunyan cannot be reduced to sermon heads; for he was not a reasoner. But he was all the more a popular preacher; for his persuasion sprang from imaginative oral realization. He pictured vividly in his own mind both things and thoughts; he had a seeing imagination. And to an equal degree he had the power of oral utterance in words that would make his hearers see and feel too. Thus his diction is habitually concrete because for him to think was to see. He makes doubt, fear, repentance real by making them visible and almost tangible. He makes us live them in the persons of his story, feel them with him because we see them with him.

The other mainspring of his appeal is a style more utterly oral than that of any other English author. He follows with fearless simplicity the ways of common speech. The proverbs that he uses so often — «a saint abroad and a devil at home,» «a waterman, looking one way and rowing another» — are no more homely than his own habitual expression. «There is a company of these crazed-headed coxcombs that when they take a fancy by the end are wiser in their own eyes than seven men that can render a reason.» «Some cry out against sin even as the mother cries out against the child in her lap, when she calleth it slut and naughty girl and then falls to hugging and kissing it.» Knowing few books but the English Bible, he has the cadences not of literature, but of talk. His style is as oral as any that was ever put into a book.

But deeper even than his vivid concreteness and his oral homeliness is the spring of his sincerity. His style is the pure expression of his own intense experience. His power still to stir men's souls wells from the agonies and triumph so vividly described in his ‹Grace Abounding,› from his going down, as he says, into the deep, his enlarged spiritual capacity. The crowning merit of the ‹Pilgrim's Progress› is that it cannot be long thought of as a work of art, that it makes us forget its style for its summons from the deceptions of things seen to the eternal unseen. Born an artist, Bunyan with single mind devoted his art to the glory of God and the salvation of men. His expression of the spiritual world is most simple and homely because he himself was simpler and homelier than any other Englishman who ever took a pen; but it is most intense because he himself was a fellow citizen with the saints.

CHARLES SEARS BALDWIN,
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PILIDIUM. See LARVA.

PILL, a form of prepared medicine consisting of a small globule convenient in size for swallowing. The ordinary weight of a pill is five grains. Some vegetable substances used as medicines may be made into pills without the addition of any other material, but usually the substances having medicinal properties are not of the proper consistence to be made into pills by themselves and require the addition of some other material, which is called an excipient. The usual excipients are bread-crumbs, hard soap, extract of licorice, syrup, molasses, mucilage, castor-oil, honey and conserve of roses. The last-named of these is especially valuable, as it preserves for a long time the proper consistency of the pills. The materials of which pills are made are mixed together until they are perfectly homogeneous and are afterward separated into pills with instruments or machinery devised for the purpose. To prevent them from adhering to one another, as well as to some extent to conceal the taste, they are covered with some fine powder, such as licorice-powder, wheat-flour, fine sugar and lycopodium. Immense numbers of pills are made by machinery and it is very common to coat them with sugar, gelatin and other substances, which are flavored and colored in various ways. Pills also sometimes receive a thin coating of gold or silver. The pill is a highly suitable form for administering medicines which operate in small doses, or which are intended to act slowly, or not to act at all until they reach the lower intestines and especially convenient in the case of substances which are strongly offensive to taste or smell. So common has the pill become for the administering of a cathartic, that pill is often synonymous for cathartic or physic.

PILLAF. See PILAU.

PILLAR, an upright, free, supporting member used in building, of any shape in section and thus to be distinguished from the column which follows the classical rules, being usually circular with a capital, while a pillar is plain and of any cross-section. The pier is heavier and broader than the pillar and usually of masonry. The term pillar is applied to the supports left for the roof in mining excavations and their rude form perhaps typifies the first step in this architectural usage.

Among the earliest peoples of which we have record the Egyptians used the pillar as an architectural member. In the remains of tombs at Beni-Hasan and elsewhere are found two types of pillars. One called the Proto-Doric is found in front of a tomb having a portico-in-antis of two columns. The resemblance of this pillar to that afterward developed by the Greeks has given it its name. The other type has received the name of lotiform from the fact that it seems to resemble a bundle of four lotus stalks bound together near the top. Above the ligature is carved the conventionalized lotus bud to form a capital. This pillar, no doubt originally constructed of wood, was adopted as the favorite order of later Egyptian builders.

A single column, as a monument, has occasionally been termed a pillar as Pompey's Pillar. See ARCHITECTURE; COLUMN.

PILLAR SAINTS (Greek, *stylitai*), the name of a class of hermits in Syria and Palestine who from the 5th to the 12th century lived on the summit of pillars in the open air. The earliest was Simon Stylites, who in 420 invented this new kind of asceticism, professing a desire to do public penance and make vicarious atonement for others' sins. Accordingly he built a pillar 18 feet high and 3 feet wide at the summit. This he eventually raised to 60 feet high and 6 feet broad. There he lived for 37 years. His example was widely followed by a succession of hermits who, however, died out before the beginning of the 13th century.

PILLARS OF HERCULES, also called **PILLARS OF MELKART,** the latter being the Phœnician name: the peaks on either side of Gibraltar (q.v.), near which was planted the colony of Gades, now Cadiz. The Greeks, identifying the god Melkart with Hercules, their own guardian of travelers, called the place the Pillars of Hercules. See CALPE.

PILLING, James Constantine, American ethnologist: b. Washington, D. C., 1846; d. 1895. He received his education at Gonzaga College, Washington, and in 1872–79 was a member of the Rocky Mountain Geological Survey with Major J. W. Powell. This expedition afforded Pilling an excellent opportunity to study the Indian dialects of the region. He became chief clerk of the Bureau of Ethnology in 1879 and two years later was made chief clerk of the United States Geological Survey. He published bibliographies on several Indian languages and a general work under the title, ‘The Languages of the North American Indians’ (1885).

PILLNITZ, pĭl'nĭts, a palace of the king of Saxony, on the right bank of the Elbe, seven miles from Dresden. The court remains here for some time each year. Pillnitz is famous for a meeting of the Emperor Leopold II, Frederick William II of Prussia, the Count of Artois, the ex-minister Calonne and several other personages, from 25 to 27 Aug. 1791. A treaty of offensive alliance was not concluded, but preliminaries were agreed on for a defensive alliance between Austria and Prussia, which was settled at Berlin, 7 Feb. 1792. The French were greatly irritated by this convention, which they considered as the basis of the coalition of Europe against France.

PILLORY, an old-time mechanism for punishment, consisting of a frame of wood erected on posts, with movable boards, and holes through which were put the head and hands of the criminal. In this situation criminals in Great Britain were formerly often exposed to the outrages of the mob in a way inconsistent with any rational notions of punishment. Those who were offensive to the crowd were in no small danger from the missiles by which they were assailed. The culprit was allowed to make speeches, defending himself and attacking his enemies. In England this punishment was first meted out for mean offenses, as using false weights, perjury and forgery, but it was extended to include libelers, and finally any who printed without a license. In 1816 this punishment was abolished in all cases except that of perjury. It was abolished totally in 1837, and in the United States in 1839. The exception was Delaware, which adhered to ancient methods of punishment until 1905.

PILLOW, Gideon Johnson, American soldier: b. Williamson County, Tenn., 8 June 1806; d. Lee County, Ark., 6 Oct. 1878. He was graduated at the University of Nashville, studied law, became prominent in the Democratic party of the State, and in 1844 as delegate to the National Convention did much to secure the nomination of Polk, his intimate friend, for the Presidency. In 1846 he was commissioned brigadier-general, immediately went to the front with his Tennessee volunteers, fought bravely at Vera Cruz, was severely wounded at Cerro Gordo, became second in command to General Scott, was again wounded at Churubusco, and after the war was accused by Scott of insubordination, but acquitted. His difference with Scott as to the Convention of Tacubaya seems to have been the origin of these charges. He opposed secession at first, acquiesced later, was made major-general of Tennessee troops, raised 35,000 men, and advanced to the Confederate government much money, which was never returned. Jefferson Davis disliked him and reduced his rank to brigadier. He fought under Leonidas Polk at Belmont 7 Nov. 1861, opposed the surrender of Fort Donelson February 1862, and thereafter did not figure in any battle save Murfreesboro, in which he had a courtesy command. He was ruined by the war, and tried heroically but vainly to recover his former financial position.

PILLOW, Fort. See FORT PILLOW.

PILLOW-LACE. See LACE.

PILLSBURY, pĭlz'bĕr-ĭ, **Harry N.,** American chess-player: b. Somerville, Mass., 5 Dec. 1872; d. Philadelphia, Pa., 17 June 1906. He won the world's championship at the Hastings International Chess Congress in England, in 1895, the first American to attain that honor since 1858. He tied with Tarrasch in 1898 in the international cable match at Vienna, divided second honors with Janowsky and Maroczy in 1899 and won first prize at the American tournament in Buffalo in 1901, and was an honored competitor in the leading international games. In 1897 he won the American championship by defeating J. W. Showalter. He made a record for blindfold play, conducting 22 games at one time, without sight of the boards or pieces, and winning most of the games. He was also a checker player of the first order.

PILLSBURY, John Sargent, American legislator: b. Sutton, N. H., 29 July 1828; d. Minneapolis, Minn., 18 Oct. 1901. He was engaged in various business ventures until 1872 when he became a member of the noted flour milling firm of Charles A. Pillsbury and Company. At the outbreak of the Civil War he organized three regiments for the Union army and later he assisted in the organization and equipment of other regiments for the suppression of an Indian uprising in Minnesota. In 1863 he was sent to the State senate and served almost continuously until elected governor in 1875, to which office he was twice re-elected. During his administration he prevented the repudiation of the Minnesota State Railway bonds and favored measures to benefit the agricultural portions of the State. He was a generous benefactor of educational institutions, hospitals, libraries, etc.

PILLSBURY, Parker, American reformer: b. Hamilton, Mass., 22 Sept. 1809; d. Concord, N. H., 7 July 1898. He was graduated in 1838 from Gilmanton Theological Seminary, studied also at Andover and became pastor of the Congregational Church at New London, N. H. Under the influence of William Lloyd Garrison's pleas, he joined the anti-slavery forces, withdrew from ministerial duties and became an anti-slavery lecturer in New England and the West. In 1854 he went to England and there lectured in the principal cities. He was one of the more violent of the abolition orators, but in his way effective. At different times he was editor of the *Herald of Freedom* at Concord, N. H., and of the *Anti-Slavery Standard* in New York. In his later years he was a preacher for various Western religious societies. He published his recollections of the anti-slavery struggle and its leaders as ‘Acts of the Anti-slavery Apostles’ (1883).

PILLSBURY, Walter Bowers, American psychologist: b. Burlington, Iowa, 21 July 1872. In 1888–90 he studied at Penn College, Oskaloosa, Iowa, and in 1892 was graduated at the University of Nebraska and in 1896 received the degree of D.Ph. at Cornell University. In 1895–97 he was assistant in psychology at Cornell, in 1897–1900 instructor, in 1900–05 assistant professor, in 1905–10 junior professor of philosophy and director of the psychological laboratory at the University of Michigan. In 1910–11 Professor Pillsbury was president of the American Psychological Association and in 1907 of the Western Philosophical Association. His publications include ‘Attention’ (1908); ‘Psychology of Reasoning’ (1910); ‘Essentials of Psychology’ (1911); ‘Fundamentals of Psychology’ (1916). With E. B. Titchener, he translated Külpe's ‘Introduction to Philosophy’ (1897), and in 1917 was chairman of the editorial committee of ‘Studies in Psychology,’ in honor of Professor Titchener.

PILMOOR, Joseph, American Episcopal clergyman: b. Tadmouth, Yorkshire, England, 31 Oct. 1739; d. Philadelphia, Pa., 24 July 1825. He was educated in John Wesley's school at Kingswood, entered the Methodist ministry in 1765 and in 1769 came to America where he assisted in establishing the Methodist faith. He founded the first Methodist church built in Philadelphia and preached in the interests of the Wesleyans until 1774, when he returned to England, angered at what he considered Wesley's injustice in having omitted him from the «legal hundred.» In 1785 he again took up his residence in America, was ordained in the Episcopal Church in that year and held charges in Philadelphia and New York. In 1804 he became rector of Saint Paul's, Philadelphia, which post he retained for 20 years.

PILOCARPIN. See Jaborandi.

PILON, Germain, zhăr-măṅ pē-lōṅ, **French** sculptor: b. Paris, 1535; d. there, 4 Feb. 1590. He was a favorite court sculptor of Catherine de' Medici. Many of the works were destroyed in the Revolution. The earliest extant is a canopy for the tomb of Francis I at Saint Denis. In the chapel of Saint Eustache at Saint Denis is also the famous tomb of Henry II on which Pilon was occupied from 1564 to 1583. His ‘Three Graces,’ ‘Saint Catherine du Val des Ecoliers,’ erected by Cardinal Birogue in honor of his wife, the tomb of the cardinal himself, ‘The Four Cardinal Virtues,’ and others are now in the Louvre. A statue ordered by Catherine, ‘Vièrge de Pitié,’ is now in the church of Saint Paul and Saint Louis, Paris. Pilon, in the voluminous folds and tortuous lines in the draperies of his figures, marks the beginning of the decadence from the classic simplicity and strength of his immediate predecessor, Jean Gonjon.

PILOS. See Hats and Hat-making.

PILOT, The; a Tale of the Sea, published in January 1824 (the earliest edition is actually dated 1823), was James Fenimore Cooper's fourth novel and his first sea tale. He had undertaken to surpass Scott's ‘Pirate’ (1821) in seamanship, and, a sailor by profession, not only succeeded in this but produced a book on almost every count better than its model. Indeed, Cooper may be said in ‘The Pilot’ to have created a new literary type, the tale of adventure on the sea, in which, although he was to have followers and rivals in many modern languages, he still keeps a high place for vigor and variety. Smollett had already discovered the racy humors of seamen, but he had seen little else in their calling; it remained for Cooper to capture for fiction the mystery and beauty, the shock and thrill, of the sea, which in his pages has much of the proud pomp of Byron's ocean. Experts say that Cooper's technical knowledge was sound; what is more important, he wrote a story about sailing vessels which convinces land-dwellers even in days of steam. Although based, with many realistic details, upon his own experience, ‘The Pilot’ has a large conventional element, chiefly in connection with its hero, John Paul Jones, who appears as always brooding upon a dark past and a darker fate. Yet he is not so morbid but that he can occasionally rouse himself to terrific activities in his raids along the English coast. Cooper credits him with a love affair, conventional in tone, and not important. Of the characters, only one possesses much interest or verisimilitude — Long Tom Coffin, of Nantucket, who takes his place worthily beside Harvey Birch and Natty Bumppo. If he seems hardly so vivid a patriot as the spy it is because he is first of all a sailor, and belongs to the open sea as Leather-Stocking belongs to the forest. Long Tom is as real as an oak; he is also as romantic as storms and tides.

Carl Van Doren.

PILOT CHART. See Chart.

PILOT-FISH, any of several fishes reputed to act as guides and sentinels to sharks, or resembling species so acting. The fish traditionally so called (*Naucrates auctor*) is a small mackerel-like member of the family *Carangidæ* (q.v.), which abounds in all warm seas, and was well known in the Mediterranean where the ancient fishermen observed its constant association with sharks, and its habit of following ships for many days together. They said it acted as a guide and protector of the sharks, leading them to prey and warning them of danger; and that when a mariner lost his way on the high seas it appeared and piloted him to port. The association with sharks and other large fishes and the following of ships are still observable, but the modern explanation is that the little fish gain food and some protection from the big ones, and, therefore, seek to swim near them. They are excellent eating. Another nearly related fish (*Seriola sonata*), one of the amber-fishes, is called "shark's pilot" along the south Atlantic Coast of the United States; in the West Indies several chichlids are called black, or cow, or cockeye pilots; and in Lake Champlain this name is given to a white-fish (*Coregonus quadrilateralis*) called Menominee or round white-fish in the Northwestern lakes. Consult Goode, ‘Fishery Industries, Sec. I’ (1884); Day, ‘Fauna of British India: Fishes’ (1889).

PILOT AND HIS WIFE, The (‘Lodsen og hans Hustru’), a novel by Jonas Lie, appeared in 1874. Lie is above all the story-teller of maritime life, and he has written many excellent novels dealing especially with sailors and fishermen and with scenes on the Norwegian coast. ‘The Pilot and His Wife’ portrays the life of the sailor both at home and abroad and gives us many a vivid picture of varied experiences out on the stormy deep as well as in distant ports. The work is noted for its vigor of description. With a background of ocean waves it is a story of married life, full of serious meaning. Salve Kristiansen loved a beautiful woman named Elisabeth and was evidently loved in return. But for a time Elisabeth was attracted to a young officer who wished to marry her. The old love for Salve prevailed, however, and Elisabeth spurned the officer, but Salve had already left his native land in desperation and was sailing toward foreign shores. When he finally, after some years, returned to his old home, he found that Elisabeth, after all, had been true to him. He married her, and it would seem that all was well, but such was not the case. The thought of Elisabeth's momentary hesitation did not leave Salve, and this unfortunate circumstance made life miserable for both. Ten years elapsed before husband and wife finally came to a clear understanding and a genuine appreciation of one another, and now at last they were enabled to lay the foundation for a happy life together. What the novel emphasizes is the need of implicit confidence and trust, if two persons united in wedlock are to live happily together. The author showed that there can be no joy in married life, if misgivings and doubts are allowed to flourish. If there is to be love, there must be no hypocrisy. Consult Henrik Jaeger, ‘Illustreret norsk Literaturhistorie’ (II: 768–825); Arne Garborg, ‘Jonas Lie, en Udviklingshistorie.’

Joseph Alexis.

PILOT KNOB, any one of various hills conspicuous from a coast or harbor, and used by pilots as an aid in setting their course.

PILOT MOUNTAIN, in North Carolina, on the border of Stokes and Surrey counties near Ararat River. See Ararat.

PILOT AND PILOTAGE. A pilot is a seafaring man familiar with a particular coast, who is licensed by the government or State to navigate vessels within a particular district. In every large harbor where there is much water traffic, pilots go out in small boats or tugs to meet incoming steamships, and take them safely into port. It is the pilot's business to know all about shifting sandbars, or other obstructions to navigation, to keep accurate watch of tides and to be thoroughly familiar with local currents and conditions. When he comes aboard of a vessel that has called him, he goes at once to the wheelhouse, and takes charge. In Great Britain and the United States every qualified pilot on his appointment receives a license for a particular district from the pilotage authority of that district. Masters or mates of any ship may, upon giving due notice, be examined and passed by the proper authorities, and receive pilotage certificates. In this case they must be renewed every year. Further, any master or mate of a ship may obtain, after examination, a certificate to the effect that he is authorized to pilot any ship or ships belonging to the same owner of and under a certain draft of water. Any qualified pilot who commits any fraud against the customs or excise, or is guilty of corrupt practices as to ships, cargoes, crews or passengers; who lends his license, acts as pilot while suspended or when drunk, causes unnecessary expense to enhance his own or someone else's gain; declines, without reasonable cause, to go off when signaled for or required; unnecessarily cuts or slips a cable; refuses to conduct a ship into port, except on reasonable ground of danger to the ship; or leaves the ship of which he is in charge, without the master's consent, before the service for which he was hired has been performed — renders himself liable to suspension or dismissal, as well as to a fine in addition to damages to the persons aggrieved. Pilotage fees depend on the draft of water of the ship piloted, and for vessels with a large draft of water are very much higher than for those with a small one. In Great Britain no owner or master of any ship is answerable to any person for any loss or damage occasioned by the fault or incapacity of any qualified pilot acting in charge of such ship within any district where the employment of such pilot is compulsory; but the pilot must not be interfered with in the discharge of his duties. Other maritime countries have also passed laws to regulate the pilotage of vessels. In the United States each individual State makes its own regulations as authorized by act of Congress. The most important body of pilots in the United States are those under the pilot commissioners of New York. The master of a vessel with a pilot on board has still the management of the vessel, and sees that she is kept in the course the pilot directs. A master refusing to take a pilot often vitiates the insurance on the vessel.

PILOT-PLANT, the compass-plant (q.v.).

PILOT SNAKE, a rustic name in the United States for several different snakes, as the mountain blacksnake (*Zamenis obsoletus*), which is harmless, and the copperhead (q.v.), which is venomous.

PILOT WHALE, a caaing whale (q.v.).

PILOTY, pē-lō'tē, **Ferdinand**, German painter: b. Munich, 8 Oct. 1828; d. there, 21 Dec. 1895. After studying in the academy of his native city, he directed his artistic activity altogether under the influence of his brother Karl von Piloty, especially imitating him in technique and color. A number of his historical frescoes are to be seen in the National Museum at Munich and in the town-hall of Landsberg-on-Lech. He also painted in oils for the Maximilaneum at Munich the picture ‘Elizabeth of England reviewing her Troops in Sight of the Armada.' Of his other works, among the most notable are 'Sir Thomas More in Prison'; 'Raffael on a Sick Bed'; 'Count Eberhardt of Würtemberg by the Dead Body of his Son'; 'The Judgment of Solomon.' He designed many illustrations for Schiller's 'Glocke' and for the Shakespeare Gallery.

PILOTY, Karl von, German painter: b. Munich, 1 Oct. 1826; d. there, 21 July 1886. After attending for a short time the Munich Academy, where he especially attached himself to the guidance of Schnorr, he joined the lithographic business of his father. He later fell under the influence of his brother-in-law, Schorn, whose realistic teaching he enthusiastically accepted and later was molded by the colorists of Belgium and France. Beginning as a genre painter in his remarkable canvas 'The Nurse' (1853) he revealed for the first time a most brilliant technique which inaugurated a new style at Munich, and indeed throughout Germany. Two years later he was appointed professor in the Munich Art Academy. In 1854 he produced his first historical picture 'The Institution of the Catholic League,' which, despite its fine color scheme, was marred by a too emphatic and theatrical action, and a lack of depth and spirituality of expression. A long series of paintings of the same class followed this, and among them, 'Seni by the Corpse of Wallenstein' (1855), an important work, now in the New Pinakothek at Munich; 'Nero amid the Ruins of Rome' (1861); 'Godfrey de Bouillon with the Pilgrims at the Holy Sepulchre'; 'Assassination of Julius Cæsar' (1865); 'Columbus' (1866); 'Thusnelda in the Triumphal Procession of Germanicus' (1873), a replica of which is in the Metropolitan Museum of New York; 'The Death of Alexander' (1877), unfinished. He painted many portraits and designed illustrations for Shakespeare, and the German classic writers. In 1874 he was director of the Munich Academy. In his style he turned from classicism to realism; and was inclined to choose subjects of a melancholy or tragic caste, and sometimes was given to the melodramatic treatment of a theme, but his drawing, coloring and handling were masterly. As the representative of a distinct school in German art he counts among his pupils and followers Makart, Max, Defregger, Lenbach, J. Brandt, etc. Consult Rosenberg, 'Die Münchener Malerschule' (1887).

PILPAY, pĭl'pī, or **PILPAI.** See Bidpai.

PILS, pēlz, **Isidore Alexandre Auguste,** French painter: b. Paris, 1815; d. Douarnenez, Brittany, 3 Sept. 1875. The son of an artist and soldier, he studied with Lethière and Picot and in 1838 gained the Grand Prix de Rome. His first success, after trying religious subjects, was in 1848 with 'Rouget de l'Isle chantant pour la première fois la Marseillaise' (Louvre). His greatest successes were with military scenes such as 'Débarquement en Crimée' and 'Bataille de l'Alma,' and water-color studies of soldiers during the siege of Paris. He was professor at the École des Beaux Arts and Membre de l'Institut.

PILSBRY, pĭlz'brĭ, **Henry Augustus,** American conchologist: b. Iowa City, Iowa, 8 Dec. 1862. He was educated at the State University of Iowa, from which he received the degree of D.Sc. in 1899. He has made a lifelong study of mollusks and has been special curator of the department of mollusks at the Philadelphia Academy of Natural Science since 1888. He has published 'The Manual of Conchology' (26 vols., 1888–1911); 'Marine Mollusks of Japan' (1895); 'Guide to the Study of Helices' (1907); 'Barnacles of the United States' (1907); also about 200 articles on conchology, geology and zoology, published in scientific journals and publications of American and foreign learned societies.

PILSEN, pĭl'sĕn, Austria, a city of the Austrian crownland of Bohemia, at the confluence of the Radbusa with the Mies (Beraun), 53 miles southwest of Prague. It consists of the town proper and extensive suburbs; is a well-built, handsome place; has a splendid Gothic church of the 13th century; a townhouse, Franciscan monastery, a German and Czech theatre, German and Czech gymnasia, barracks; and important and varied industries, embracing machinery and metal wares, porcelain, glass, liquers, refined spirits, etc., and large breweries which produce a famous variety of beer. Coal, iron and alum mines are in the vicinity, and there is a considerable trade. Pilsen possessed a printing-press as early as 1468. It was once a fortified town, and was several times besieged during the Hussite wars. In 1618 it was stormed by Mansfield, and in the Thirty Years' War was for a time the headquarters of Wallenstein. The people are mainly Czechs. It has grown fast in modern times from 38,883 population in 1880 to 84,800 in 1914.

PILUM. See Javelin.

PILZ, pĭlts, **Vincenz,** Austrian sculptor: b. Warnsdorf, Bohemia, 1816; d. 1896. He studied both painting and sculpture at the Vienna Academy, but eventually came under the influence of Führich and Rahl and gave all his attention to sculpture, producing many groups and reliefs under the approval of these masters. Among his works are the two 'Winged Horses' in front of Memorial Hall, Philadelphia; the 'Neptune' of the Vienna Exchange and 'Science and Commerce' at Windsor Castle, England. He also decorated public buildings at Vienna with statues of Austrian generals, celebrities of antiquity and modern composers.

PIM, Bedford Clapperton Trevelyan, English naval officer: b. Biddeford, England, 12 June 1826; d. London, England, 1 Oct. 1886. He was educated at the Royal Naval School and entered the English navy in 1842; took part in the Franklin search expedition in 1852; commanded a gunboat on the Baltic during the Crimean War; served in China in 1857, and was promoted commander in 1858. In 1859 he served in Central America and surveyed the Nicaragua Canal route. He was retired from active service in 1861, but received rank as rear-admiral in 1885. He was admitted to the bar in 1873 and was a member of Parliament 1874–80. He wrote 'The Gate of the Pacific' (1863); 'Jottings on the Roadside in Panama, Nicaragua and Mosquito' (1869); 'The War Chronicle' (1873), etc.

PIMAN (pē'mạn) **STOCK,** an American family or group residing in Mexico and Arizona. The stock includes among other tribes the Papagos, Pimos, Gatschets, Tarumaris, Yaquis and Huichols. The Piman family is a southern extension of the Shoshone (q.v.) family. They number about 90,000. Consult Russell, F., 'The Pima' (in 26th Annual Report, Bureau of American Ethnology, Washington 1908).

PIMENTO. See Allspice.

PIMLICO. See Friar-bird.

PIMO, or **PIMA INDIANS,** an American tribe of the Piman family, living in New Mexico, in the valley of the Gila. They are neighbors of the Maricopas, whom they resemble so much in person and manners that they are not easily distinguished from them. Their number is about 4,000. The men have slender forms, but the women, who do most of the hard labor, are well made. Agriculture is their principal occupation. They are the most civilized of any of the North American Indians; they manufacture cotton fabrics, pottery and other useful articles with considerable skill, and enjoy a reputation for simplicity of character, peacefulness and honesty. The only weapon used by the tribe is the bow and arrow. They possess horses and cattle, but very few mules. About two-thirds of the Pimos live on government reservations. See Piman Stock.

PIMPERNEL, a flowering plant of the primrose family and genus *Anagallis,* with a wheel-shaped corolla. The scarlet or field pimpernel (*A. arvensis*) is wild in Europe, and both cultivated and run-wild all over the world. The small flowers are usually scarlet with a purple spot in the centre, but in one variety blue. This species is commonly known in England as the "poor man's weather-glass," from the fact that its flowers do not open in rainy weather. The bog pimpernel (*A. tenella*) is an extremely delicate and beautiful plant, which naturally grows in the drier parts of marshes; its flowers are red, and it is distinguished from the field pimpernel by the fact that its corolla considerably exceeds the calyx. The blue and lilac varieties of *A. collina,* a native of South Africa, have been introduced into gardens generally, where they have a fine effect. A closely allied plant (*Centunculus minimus*) is called false pimpernel or chaff-weed.

Another group of pimpernels is the genus *Pimpinella* of the *apiaceæ,* relatives of the snake-root. A widespread and representative species is *P. saxifraga,* sometimes called burnet saxifrage.

PIMPLES, eruptions of the skin, of which several varieties are distinguished by special names, but various causes may transform one of these into another. The typical pimple is a slight swelling with an inflamed base. The papule is a solid elevation, apparently containing no fluid, and either of the natural skin-color, or bluish, blackish, etc. The vesicle is an elevation of about the same size, containing a clear or milky fluid; by alteration of its contents to yellow pus it becomes a pustule. A bleb or bulla is a larger vesicle or pustule, and may be as large as a hen's egg. A large papule is called a tubercle, and wheal is the term applied when the raised skin is of greater extent than elevation.

PIN, a small piece of brass or steel wire, sharp at one end and furnished with a head at the other, used chiefly for the toilet for temporarily securing portions of the dress, and generally by seamstresses and tailors for fastening their work together. The need of little utensils of this sort has been met from ancient times by various devices. The original pin must have been slit from the shaft of a bird's feather, as the root word, Latin *pinna,* means feather. In the Egyptian tombs they are found much more elaborate and costly than the pins of the present time. They vary in length up to seven or eight inches, and are furnished sometimes with large gold heads, and sometimes with a band of gold around the upper end, those of the latter kind having probably been used for securing the hair. The ancient Mexicans found in the thorns of the agave convenient substitutes for metallic pins; and even the English, up to the middle of the 16th century, made use of rude skewers of wood, though they also made others of gold, silver and brass to serve as pins. To that time they had depended upon the manufacturers on the Continent for their supplies of the better sorts of pins, and this importation appears to have been established previous to 1483, when it was interrupted by a prohibitory statute. In 1543 an act of Parliament provided "that no person shall put to sale any pins but only such as be double-headed and have the head soldered fast to the shank of the pin, well smoothed, the shank well shaven, the point well and roundly filed, canted and sharpened." Within three years from this time the manufacture was so much improved that the statute was of no importance. In Gloucester the business of pin making was introduced in 1626, and soon proved so prosperous that it gave employment to 1,500 persons. It was established in London in 1636, and afterward in Birmingham, which became the chief seat in England of this and other manufacturing operations of similar character.

In the United States pins were first made in Rhode Island during the Revolution by Jeremiah Wilkinson, the heads being made by twisting fine wires firmly at one end. Samuel Slocum at about the same time commenced in Providence in the same line. In 1824 a machine for making solid-headed pins was invented by Lemuel W. Wright, of New Hampshire, which was soon after introduced into England, patents also being granted there. It was, however, crude compared with those of later construction, and did not complete all the operations of pin making. In 1831 the first machine for making perfect solid-headed pins like those now in use was invented by John Ireland Howe, a physician of Bellevue Hospital, New York City, and in the next year a company was started in that city. Six years later the business was removed to Derby, Conn., where it is still carried on. In 1835 another company was formed by Dr. Howe, which continued its operations under his charge till 1865, many improvements being made. Samuel Slocum, an ingenious Connecticut man, invented a pin-sticking machine, which was used in Howe's factory in 1841, and was improved in 1843, he and Slocum becoming joint owners of the two patents.

The manufacture of pins has become such an industry in the United States that the mills of this country practically supply the world with this article. In 1900 the 75,000,000 people in the United States used 60,000,000 gross of common pins, which is equal to 8,600,000,000 pins, or an average of about 113 pins for every man, woman and child in the country. This is the highest average reached anywhere in the use of pins. In 1890 we used only about 72 pins each. Assuming that the present consumption is 125 per individual, the 110,000,000 people of the United States in 1918 used about 10,375,000,000 pins. The census lumps together the makers of pins, needles, hooks and eyes, so exact statistics are no longer available. It appears, however, that more than half the pins are made in the State of Connecticut, where there are eight factories, employing 3,000 people.

The common pin is of brass with a tinned surface. Pins now are turned out by automatic machines in such quantities that the cost of manufacture is slightly greater than the value of the brass wire from which they are made. A single machine does the work. Coils of wire, hung upon reels, are passed into machines which cut them into proper lengths, and they drop off into a receptacle and arrange themselves in the line of a slot formed by two bars. When they reach the lower end of the bars they are seized and pressed between two dies, which form the heads, and pass along into the grip of another steel device, which points them by pressure. They are then dropped into a solution of sour beer, whirling as they go, to be cleaned, and then into a hot solution of tin, which is also kept revolving. They here receive their bright coat of metal, and are pushed along, killing time, until they have had an opportunity to harden, when they are dropped into a revolving barrel of bran and sawdust, which cools and polishes them at the same time. Because of the oscillation of the bran they work gradually down to the bottom of the barrel, which is a metallic plate cut into slits just big enough for the body of the pins, but not big enough for the head to pass through. Thus they are straightened out into rows again, and, like well drilled soldiers, pass along toward the edge of the bottom, and slide down an inclined plane, still hanging by their heads, until they reach strips of paper, to which they are introduced by a curious jerk of the machine. The first they know they are all placed in rows, wrapped up and on their way to the big department stores, where they are sold at a small price. A machine is expected to throw out several thousand gross an hour. Hairpins and safety pins and other kinds of pins are all manufactured by somewhat similar special machinery.

The word pin is applied in mechanics to any relatively small straight piece of metal that serves to join parts. The crank-pin of a great steamship's mainshaft may weigh a ton, whereas a pin in a watch-plate may be difficult to discern. A wooden pin is now more commonly called a peg. Both needles and hairpins are manufactured to a greater extent in Europe than plain pins. Safety pins, however, are decidedly American, and of these we make on an average 1,000,000 gross a year.

PIN-MONEY, the money which a husband hands a wife for minor personal expenses; in law, an annual sum of money, sometimes provided for in a marriage settlement, to be paid by the husband to the wife for her separate use, and to be applied in the purchase of apparel, ornaments for her person or for private expenditure. See HUSBAND AND WIFE.

PINA (pē'nyä) **CLOTH**, an extremely soft and delicate fabric, the manufacture of which is peculiar to the Philippines. It is made from the unspun fibres of the leaves of the cultivated pineapple plant, and the finer qualities are always made in small pieces, since only single fibres are used for them. For the coarser qualities several fibres are often joined together, so as to make warp threads of considerable length. Its color is almost white. but has a slight tinge of yellow in it. Its chief use is for making ladies' pocket handkerchiefs, which are frequently adorned with exquisite embroidery.

PINAFORE, H. M. S., a comic opera in two acts, libretto by W. S. Gilbert, music by Sir Arthur Sullivan; first produced at the Opéra Comique in London, 25 May 1878. First authorized appearance in America, November 1879, at the Boston Museum. Replete with those nonsensical whimsicalities which have given the word «Gilbertian» to the English language, this opera with its dainty music became an immediate success. The captain of H. M. S. *Pinafore* wants his daughter (Josephine) to marry Sir Joseph Porter, First Lord of the Admiralty, but she is in love with Ralph, a sailor. They agree to elope, but their plan is betrayed by Dick Deadeye, the villain. A bumboat woman, Little Buttercup (in love with the captain), informs the First Lord that the captain and Ralph had accidentally been exchanged as infants. To rectify this error, the First Lord reduces the captain to ordinary sailor and makes Ralph captain. Both Josephine and Little Buttercup wed the lovers of their choice under this grotesque arrangement and with the blessing of the First Lord.

PINAKOTHEK, pĭn'ą-kō-thĕk (Ger. pē-nä-kō-täk') (Greek, «collection of pictures»), anciently, a chamber in which votive pictures of the gods were hung in Greece. Such a chamber was situated in the left wing of the propylæum or gate of the acropolis at Athens. In other states (Samos, Ephesus, etc.) special buildings were raised for the storing of votive tablets. Among the Romans the entrance to the atrium of their houses was adorned with statues, pictures and other objects of art. In Munich at the present day the term is applied to a public art gallery, and there is in that city an old and a new pinakothek.

PINALOBO, pē-nä-lō'bō, a mountain of the Cordillera de Cabusilan, Philippines, in the northwestern part of the province of Pampanga, near the intersection of the boundary of Tárlac and Pampanga with Zambales. It is 6,040 feet in height, and the highest of a series of peaks which ends in the south with the Mariveles summits and forms a landmark for Súbic Bay and for vessels approaching Manila Bay from Hongkong and northern China.

PINAR DEL RIO, pē-när' dĕl rē'ō, Cuba, the most western province of the island, bounded on the east by Habana province, area, 5,212 square miles. The Cordillera de los

Organos traverses the centre of the province from east to west, and from this range the land slopes gradually to the coasts, which are generally low and marshy. The southern slope is the most fertile, and forms the famous Vuelta Abajo, where the finest quality of tobacco in the world is grown. This tobacco is the staple crop of the province; but coffee, sugar and fruits are also raised. The mountains are heavily wooded, mainly with pine, and lumbering is an important industry; some cattle are also raised; and charcoal is manufactured. The mineral resources are comparatively unimportant and have not been developed; asphalt and copper are found. Pop. 269,166.

PINAR DEL RIO, Cuba, city, capital of the province of Pinar del Rio, 95 miles southwest of Havana. It was founded in 1776. It is connected with Havana by rail and with La Coloma by highway, and being situated on the southern slope of the mountains is the commerical centre of the tobacco-growing district, Vuelta Abajo. It has grown very rapidly in recent years. Pop. 52,472.

PINASTER. See PINE.

PINCHBACK, Pinckney Benton Stewart, American lawyer and politician: b. Macon, Ga., 10 May 1837. He was of negro stock, studied in the public schools of Cincinnati, became a river boatman, and in 1862 enlisted in the Union army. In 1867 he was made inspector of customs at New Orleans. He took a prominent part in politics as a Republican leader; was a delegate to the Reconstruction Convention of the State in 1867; was State senator, 1868–71, lieutenant-governor, 1871–72, and acting governor during Warmoth's impeachment December–January 1872–73. He was elected to the United States Senate in 1873, but was never seated though he received regular pay and mileage; in 1882 was named surveyor of customs of New Orleans; and in 1886 was admitted to the bar, but a few years later retired from practice.

PINCHBECK, an alloy formerly in use, four parts copper and one part zinc, with occasional traces of tin, used in the manufacture of cheap jewelry. It has something the appearance of gold, but became notable as a synonym for cheapness. It was named from its discoverer, CHRISTOPHER PINCHBECK, a London jeweler: b. about 1670; d. 18 Nov. 1732. He made clocks, watches, astronomical instruments and various automata, especially musical, which he exhibited at fairs.

PINCHE, a sort of marmoset (q.v.).

PINCHOT, pĭn'shō, **Amos Richard Eno,** American lawyer and publicist: b. Paris, France, 6 Dec. 1873. In 1897 he was graduated at Yale University and subsequently studied law at Columbia University and the New York Law School. Mr. Pinchot served in Porto Rico during the Spanish-American War and in 1900–01 was deputy assistant district attorney of New York County (borough of Manhattan). Mr. Pinchot became an active worker along sociological lines and wrote much on industrial, charity and social organization generally. He supported Theodore Roosevelt in 1912 in organizing the Progressive party, but left the party two years later after a controversy with George W. Perkins, of the Harvester Trust. He is a trustee of the People's Institute and one of the founders of the Pinchot School of Forestry of Yale University.

PINCHOT, Gifford, American forestry expert: b. Simsbury, Conn.. 11 Aug. 1865. In 1889 he was graduated at Yale University, after which he studied forestry in France, Germany, Switzerland and Austria. In January 1892 he began the first systematic forest work in the United States at Biltmore, N. C. His work there attracted general notice and in 1893 he establishing himself in New York as consulting forester. He became member of the National Forestry Commission in 1896. From 1898 to 1910 he was forester and chief of division of the Bureau of Forestry, afterward the Forest Service of the United States Deoartment of Agriculture. Since 1903 he has held the chair of forestry at Yale and since 1910 has served as president of the National Conservation Association. In 1902 Mr. Pinchot inspected the forests of the Philippines and recommended a forest policy for the islands. He also served on various commissions, dealing with conservation, waterways, etc. In 1909 he was engaged in a controversy with Secretary Ballinger over the policy of the latter's department, which Pinchot claimed was inimical to the best interests of the people. In 1910 the President dismissed Pinchot for insubordination and in the inquiry subsequently instituted by Congress Ballinger was held blameless («whitewashed»). Public opinion, however, sustained Pinchot, who was undoubtedly right in his assumptions and justified in opposing the reactionary schemes of the Taft administration. In 1912 Mr. Pinchot supported the Progressive party and in 1914 was that party's candidate for United States senator from Pennsylvania. He failed of election, however. He is one of the founders of the Pinchot School of Forestry at Yale. In 1915 he started to perform relief work in Belgium but was expelled by the Germans, because his family was allied by marriage with a member of the British diplomatic service. Mr. Pinchot has published 'The White Pine' (1896); 'The Adirondack Spruce' (1898); 'Primer of Forestry' (1899): 'The Fight for Conservation' (1909); 'The Country Church,' with C. O. Gill (1913).

PINCKNEY, pĭnk'nĭ, **Charles,** American statesman: b. Charleston, S. C., 1758; d. there, 29 Oct. 1824. He was educated for the bar, was elected to the provincial legislature, was held prisoner from the capture of Charleston until the end of the Revolution, then resumed practice, and in 1785 was chosen to the provincial congress. In 1787 he was a delegate to the United States Constitutional Convention, in 1789 was elected governor of South Carolina and in 1791 and 1796 was re-elected. He was elected to the United States Senate as a Republican in 1798, in 1802–03 was Minister to Spain and in 1806 was made for the fourth time governor of South Carolina. In 1819–21 he was in Congress, where he opposed the Missouri Compromise. He wrote well on political topics and his addresses to the people under the pseudonym «Republican» (1800) were of assistance in Jefferson's election to the Presidency.

PINCKNEY, pĭnk'nĭ, **Charles Cotesworth,** American soldier and statesman: b. Charleston,

S. C., 25 Feb. 1746; d. there, 16 Aug. 1825. He was educated at Oxford; read law in the Middle Temple, London; studied military affairs in the Royal Academy at Caen, France, and in 1769 began the practice of law in Charleston. He was a member of the first provincial congress of South Carolina (1775), and during the Revolution served with distinction in the Continental army. During the second attack on Charleston he at first commanded Fort Moultrie, but after the entrance of the enemy's fleet into the harbor withdrew to the city, and was taken prisoner at the capitulation in May 1780. He was held in severe confinement for two years, exchanged in 1782 and made a brigadier in 1783. In 1787 he was a member of the United States Constitutional Convention, and took an active part in the busy debates connected with the framing of the instrument. He favored the slave trade, urged a landed-property qualification for the executive, judiciary and the legislative department; and demanded that blacks be counted equally with whites in the estimate for representation in the national legislature. It was he who secured the insertion in the Constitution of the clause that «no religious test shall ever be required as a qualification to any office or public trust under the authority of the United States.» Under the Constitution he was a zealous Federalist. He was a member of the State Constitutional Convention of South Carolina in 1790 and in 1796 became United States Minister Plenipotentiary to France. Ordered by the Directory to quit France within 30 days, he retired to Amsterdam, and on his arrival in America was made (1797) major-general of United States troops by President Washington. It was during the French mission that Pinckney, in response to Tallyrand's insinuation that recognition might be obtained by money, for lack of which war might follow, is said to have replied: «Millions for defense, but not a cent for tribute!» In 1800 he was Federalist candidate for the Vice-Presidency, and in 1804 and 1808 for the Presidency.

PINCKNEY, Thomas, American diplomat and soldier: b. Charleston, S. C., 23 Oct. 1750; d. there, 2 Nov. 1828. He was educated in England with his brother, Charles Cotesworth, was called to the English bar in 1770, returned to Charleston in 1772 and in 1775 entered the Constitutional Congress as a zealous Federalist. He acted as aide to Lincoln, D'Estaing and Gates, distinguished himself in the engagements at Stone Ferry and Savannah in 1779, and at Camden in 1780 was wounded and taken prisoner, not regaining his liberty until the end of the war. In 1787–89 he was governor of South Carolina, Minister to England in 1792–94 and in 1794–96 was engaged in a special mission to Spain, with whom he secured in 1795 a treaty which granted to the United States free navigation of the Mississippi for three years. He was a member of Congress in 1799–1801 and in the War of 1812 was major-general in command of the 6th military district where he utterly routed the Creek Indians at Horse Shoe Bend. He spent the remaining years of his life in retirement. Consult his 'Life' by C. C. Pinckney (Boston 1895).

PINCKNEYVILLE, pĭnk'nĭ-vĭl, Ill., city and county-seat of Perry County, on the Illinois Central and the Wabash, Chester and Western railroads, 60 miles southeast of Saint Louis. It has extensive lumber, flouring and coal-mining interests. In 1915 the commission form of government was put in operation. The municipality owns the water-supply system. Pop. 2,722.

PINDAR (Gr. Πίνδαρος), Greek lyric poet: b. Cynoscephalæ, near Thebes, 522 B.C.; d. Argos, probably 443 B.C. For the development of his poetical talent he was sent to Athens, where he became the pupil of Lasus of Hermione, the Athenian school of dithyrambic poetry. On his return to Thebes he was especially indebted for the further cultivation of his poetic gifts to Corinna, a distinguished poetess. He was held in great honor by many princes of Greek states, for whom he composed choral songs. Alexander, king of Macedonia, was one of his most ardent patrons. He regularly attended the contests at Olympia, Delphi and elsewhere, and frequently attended the victors home to direct triumphal ceremonies. In 472 he visited Sicily, the courts of King Thero of Agrigentum and King Hiero I of Syracuse. Æschylus made a journey to the island at about the same time; and rival descriptions of the eruption of Ætna appear in the 'Odes' and in Æschylus' 'Prometheus.' Pindar practised all kinds of lyric poetry and excelled equally in all. His works embraced hymns to the gods, pæans, dithyrambs, dancing and drinking songs, dirges, panegyrics on princes and hymns in honor of the victors of the games, but the only poems of his, with one exception, which have come down to us entire belong to the last class, the 'Epinikia.' The one exception referred to is the ode which appears in editions of Pindar as the 11th Nemean, and was intended to celebrate the installation of Aristagoras as prytanis at Tenedos. Forty-five of the epinikion odes of Pindar are still extant (including the one just mentioned). Of all, undoubtedly the fourth Pythian, in honor of the victory in the chariot race of Arcesilas, king of Cyrene, is the finest. His poems celebrated not alone the conquerors and their fellow-citizens, but all assembled Greece, and thus were soon spread wherever the Greek language was spoken. To understand Pindar it is necessary to be intimately acquainted with Greek antiquities. In the judgment of the best critics his poems belong to the most beautiful remains of ancient literature. They are marked by profundity of thought, elevation of diction and majesty of rhythm. Fragments of his other works have also been preserved.

PINDAR, Odes of. Few names were so venerated among the ancient Greeks as the great Theban poet, Pindar. As Homer was their «epic poet» and Sophocles their «tragic poet,» so Pindar was their «lyric poet.» His chair was preserved at Delphi, and at the periodic theogenia or sacred festival it was the custom of the priest of Apollo to call out, «Let Pindar the poet go into the banquet of the god.» At the destruction of Thebes, Alexander the Great

> "bade spare
> The house of Pindarus, when temple and tower
> Went to the ground."

Pindar belonged to the school of Dorian choral poets. His fragments represent nearly every kind of lyric poem. These were composed as if to be sung on the spot in immediate celebration of the victory; but in the nature of the case this could seldom be, and the ode was generally composed later, to be sung at a commemoration festival at the hometown of the victor. Like all choral lyrics, the epinikion was essentially narrative; it is, however, not the story of the contest that Pindar gives, but some myth of the family or race which at once tells an appropriate tale and points a moral. This digression was the heart of the ode, but its connection with the hero's victory is not always easy to see. The ode, once composed — in strophe and antistrophe, or both these with epode — a band of youths was carefully selected to render it with song and rhythmic movement. The ancient Hellene felt, as no mortal can ever feel again, that «there is no greater glory for a man while yet he lives than that he achieves with hand and foot»; and no pains or expense was spared by the victor's fellow-townsmen to bring out Pindar's ode with proper splendor.

It is not possible for moderns to appreciate the full excellence of the Pindaric ode. It was not merely a spectacle in honor of a man; the celebration was an act of divine worship and the poet was filled with religious fervor. The odes were meant to be sung, not read, and the music is lost; besides the scenic accessories are all gone. No great poetry can be really translated, least of all Pindar. Perhaps there is no great poet in all the world's literature of whom a less adequate conception can be obtained through translations. As Jebb eloquently says, «The glory of his song has passed forever from the world with the sound of the rolling harmonies on which it once was borne, with the splendor of rushing chariots and athletic forms around which it threw its radiance, with the white-pillared cities by the Ægean or Sicilian Sea in which it wrought its spell, with the beliefs or joys which it ennobled; but those who love his poetry and who strive to enter into its high places can still know that they breathe a pure and bracing air and can still feel vibrating through a clear calm sky the strong pulse of the eagle's wings as he soars with steady eyes against the sun.» The price of knowing Pindar is high, but those who pay it have no regrets. For the great majority, Pindar is a lost art, but the few know that it is a very great art; and for the sake of our standards in literature it is devoutly to be hoped that such a saving remnant, however small, may always be found. Pindar's standard was so high and his achievements so sure that the modern world cannot afford to lose the tradition of his high excellence. While many especially great qualities might be mentioned, there is space here to emphasize only one — his style. Matthew Arnold coined the word «Pindarism» to express it, saying, «Pindar is a poet on whom, above all other poets, the power of style seems to have exercised an inspiring and intoxicating effect.» The chief characteristic of that style was splendor. «To Pindar's soul splendor was as elemental as harmony to Milton's.» This quality is best exhibited in some passages from the Epinikia, but these cannot be translated. There is a tenderer beauty perhaps in this picture from the second *Olympian* of the happy dead in the Islands of the Blest:

> " Where the soft Ocean breezes float for ever
>   Around the Islands of the Blest.
> There golden bloom to bloom succeeds,
>   Through springs that never tire.
> They fill with light the ground below,
> Athwart the shining trees they glow;
> Their growth the very water feels,
>   Hid under flowers of fire."

A similar beautiful picture is this fragment of a threnos:

> " For them the night all through,
> In that broad realm below,
> The splendor of the sun spreads endless light;
> 'Mid rosy meadows bright,
> Their city of the tombs with incense-trees.
> And golden chalices
> Of flowers, and fruitage fair,
> Scenting the breezy air,
> Is laden. There with horses and with play,
> With games and lyres, they while the hours away.
> On every side around
> Pure happiness is found,
> With all the blooming beauty of the world;
> There fragrant smoke, upcurled
> From altars where the blazing fire is dense
> With perfumed frankincense,
> Burned unto gods in heaven,
> Through all the land is driven,
> Making its pleasant places odorous
> With scented gales and sweet airs amorous."

For a discussion of English Pindaric odes, consult Edmund Gosse's Introduction to his ‹English Odes.› Gray's two Pindaric odes, the ‹Progress of Poesy› and ‹The Bard,› are perhaps the most famous in our language; Akenside's series of odes are regarded as coming nearer to the Greek model than any other imitations, but they lack inspiration. Perhaps the best English editions of Pindar are the complete edition of C. A. M. Fennell (1893–99); the ‹Olympian and Pythian Odes,› by B. L. Gildersleeve (1885); the ‹Nemean and Isthmian Odes,› by J. B. Bury (1890–92). The best translation is the prose rendering by E. Myers (revised 1883). Consult Jebb, ‹Lectures on Greek Poetry› (1893); Fraccaroli, ‹Le odi di Pindaro› (1894); also Morice, F. A., ‹Pindar,› in *Ancient Classics for English Readers.*

CHAS. FORSTER SMITH.

PINDEMONTE, pĕn-dā-mōn'tā, CAVALIERE **Ippolito,** Italian poet: b. Verona, 13 Nov. 1753; d. there, 18 Nov. 1828. He was of a rich and cultured family, and early showed signs of poetical taste and ability. He traveled in England, Germany and France, and, like the great English poets of the epoch, greeted with joy the French Revolution, publishing ‹La Francia› in 1789, but was soon disillusioned by its excesses and especially by the sufferings of Italy, which followed it. His principal poems were ‹Poesie Campestré› (1788), filled with charming descriptions of British scenery; ‹Dodici Sermoni Poetici› (1819), in a Horatian manner; and ‹Arminio› (1804), a tragedy. These are classic in manner, graceful and tinged with melancholy.

PINDEMONTE, MARCHESE **Giovanni,** Italian dramatist, brother of Ippolito Pindemonte (q.v.): b. Verona, Dec. 1751; d. there, 12 Jan. 1812. His early years were full of political ups-and-downs, now in Italy in high office and again living in exile in France. In 1802 he became a member of the Italian Parliament. He was a brilliant improvisateur, a translator of note, like his brother, and the author of 10 tragedies, of which the best are 'I Baccanali' and 'Ginevra di Scozia.'

PINDHAREES, pĭn-dăr'ēz, **PINDAREES**, or **PINDARIS**, the name given to the hordes of mounted robbers in central India who for several years (after 1812) infested the possessions of the East India Company. These freebooters had existed since 1761, but made themselves particularly formidable in the beginning of the following century. They were descended mostly from the caste of Mohammedan warriors, which formerly received high pay from the Indian princes. But the British East India Company disarmed many of the tributary native princes and maintained under the command of the British residents at the Indian courts large bodies of mercenary troops, which the mediatized nabobs were obliged to pay. The number of the Pindarees was thus increased, and they were secretly excited by the Indian tributaries to attack the company. In the last year of their excesses, 1816, they sacked over 300 villages. In 1817 the British governor-general, the Marquis of Hastings, determined on the destruction of these robbers, whose force was estimated at 40,000 horse and 160,000 infantry. Attacked on all sides, they were conquered and dispersed.

PINDUS, *in ancient geography*, the main range of northern Greece between Thessaly and Epirus, running from the northwest to the southeast, and the source in its northern part of the principal rivers of Greece, the Achelous, Haliacmon and Peneius. It includes several peaks from 6,000 to 7,500 feet high. Geologically it is calcareous in formation. The range is well watered and profusely wooded. In classic times its inhabitants were the half barbarian Athamanes and Dolopes, and the range, like Parnassus and Helicon, was sacred to the Muses and to Apollo. The inmost recesses of the mountains were the fortress and hiding place of determined brigands in the days of Ali Pasha. Its present inhabitants are peaceable shepherds and farmers, both Greek and Albanians, for the range now lies partly in Turkish and partly in Greek territory.

PINE, a genus (*Pinus*) of trees and a few shrubs of the order *Coniferæ*. The species, of which about 70 well-marked ones have been described, are natives of the Northern hemisphere and more than half are indigenous to North America. Their distribution is from the Arctic zone to near the Equator, where, however, they are found only near the snow-line on the mountains. They are characterized by resiniferous wood, foliage, etc.; usually tall trunks; spreading branches which form a pyramidal or round top; needle-like leaves arranged in clusters of two, three or five, sometimes solitary; yellow or purple staminate flowers, greenish or purplish pistillate ones, the latter developing into usually cylindrical brown cones, which vary in size from less than an inch to 18 inches long and reach maturity generally when two years old; some not until three or more years of age.

Economically the pines are more important than any other timber trees used by man; the nearest rival being the oaks. The main reasons for this eminence are the wide extant of their distribution, the enormous area occupied, their adaptability to human needs and their occurrence largely upon poor land unfit for agricultural purposes. Not only for fuel and for timber are they noted; certain species yield pitch, tar and turpentine, used extensively for naval supplies; the leaves of several are made into "pine wool" and also furnish essential oils; the seeds of other species are used as food and for flavoring; and many are serviceable as windbreaks and shelter-belts or for ornamental planting. They thrive on a wide variety of soils, from beach-sand to alluvial river bottoms or rocky mountain-sides; and usually are found in large numbers together, often to the exclusion of other trees.

Pines are readily propagated by seeds, which in some species may require more than one year to germinate, unless planted as soon as gathered. They do best in a moderately moist soil enriched only to a slight depth so as to encourage the formation to surface roots rather than tap roots. While little they generally need partial shade and care in watering, both extremes of wetness and of dryness being avoided. When two years old or younger they are transplanted to increase the stockiness of the roots and render the trees better able to stand transplanting to final quarters. In general, the species do best in dry, upland soils, sandy rather than clayey, poor rather than rich, though soils of moderate texture and richness suit them well. When removed from the nursery rows the roots should be puddled in loamy mud to prevent the drying of the rootlets. Generally, best results are obtained in transplanting in the spring before growth starts and selecting youngest specimens or such as have been transplanted in the nursery several times.

A very large number of insects feed upon the pine, nearly 300 being recorded in Europe and 200 in America, although the actual number in this country is probably twice as many. Of these probably the most troublesome are the borers, of which a very large number are known, among which the following may be mentioned: Wood-engraver bark-beetle (*Xyleborus cœlatus*), which attacks the Georgia and the white pine; coarse-writing bark-beetle (*Tomicus calligraphus*) also attacks the white pine, but seems to be more partial to the pitch pine; the white pine-weevil (*Pissodes strobi*) works, as a larva, in the leading shoot, which dies and thus forces the tree to develop a second leader, forming a crook in the trunk or branch attacked; the sawyer (*Monohammus confusor*) is a scourge of Southern pine forests; the pine-destroying beetle (*Dendroctonus ponderosa*) has greatly injured the timber of the Black Hills region by boring in the trunks; and there are many other boring beetles. The Nantucket pine-moth (*Retinia frustrana*) burrows, as a larva, in the wood of the twigs and when in sufficient numbers kills the trees. Of other insects than borers perhaps the caterpillars are most frequently troublesome. Among the best known are the larvæ of two hawk-moths (*Lipara combycoides* and *L. pinetum*); of the imperial moth (*Eacles imperialis*); and of two butterflies (*Thecla niphon* and *Pieris manapia*). These all feed upon the foliage. A leaf miner (*Gelechia pinifoliella*) burrows in the leaves. A gall midge (*Diplosis pini-rigidæ*) forms galls at the bases of the leaf-clusters and its relative (*D. resinicola*) lives in the pitch of the pitch pine. There are also many saw-flies, plant-lice and scale-insects which destroy the foliage. The best known species are the following:

White Pine (*Pinus strobus*).— In every way this is the most useful species of the genus, combining utility in many directions with ornamental qualities superior to other species, adaptability to many soils and climates and rapidity of growth with productivity. It is an American species, ranging from Newfoundland to Manitoba and southward to Illinois and in the mountains, to Georgia. It attains heights often exceeding 100 feet, sometimes 150 feet, and diameters of four or more. The white or cream-colored wood is soft, straight-grained, somewhat resinous and easily worked. It is very popular for house-building especially for making door and window-frames, shingles, blinds and interior finish. But since the forests of the northern United States and adjacent Canada have been considerably depleted other woods are replacing it for certain purposes.

Georgia Southern, Yellow, or Long-leaf Pine (*P. palustris*).— As a timber tree this species ranks next to the white pine and is the most important and most widely distributed timber tree of the Southern States. It is found upon the coastal plain from Virginia to Mississippi in a belt about 125 miles wide. It often exceeds 100 feet in height, but rarely more than 120 feet, gradually tapering from a base of about 30 inches. Its orange-brown branches form an open head; its leaves are often more than a foot long and its cones larger than those of species in the same range. The yellow, very resinous wood is the heaviest and strongest of the pines. It is extensively used for ship and bridge building, flooring and for interior finish of houses especially when such is to be left unpainted to show the grain. The tree is the most important source of turpentine, resin, etc., the obtaining of which ranks second only to its timber industry. Its leaves are one of the most important sources of a turpentine-like oil and of pine wool, to obtain which they are boiled in alkalis.

Red, or Norway Pine (*P. resinosa*).—Third in importance among American pines, this species is second in the North to the white pine as a lumber tree. It ranges from Labrador to Manitoba and south to Pennsylvania. Though usually about 75 feet tall and two feet in diameter, it sometimes doubles this height. It occurs most frequently upon dry, sandy soils, where it often forms dense forests. Its light, elastic, resinous, hard wood is durable only when in dry places and is used like that of the short-leaf pine of the South.

Spruce or Yellow Pine (*P. echinata or P. mitis*).— This species ranks second in the South to the Georgia pine and comes fourth in the American list as a lumber tree. Its range is from New York to Illinois and southward to the Gulf States, sometimes excluding other species in large tracts. It attains from 75 to 120 feet in height and a diameter of two feet. The heavy, hard, coarse-grained timber is valued for its strength and durability. It is largely used for framework, railway ties, outside finish of buildings, railway cars, etc. It also furnishes resin. As an ornamental specimen it has been found hardy as far north as Rhode Island.

Loblolly, Frankincense, or Old Field Pine (*P. tæda*).— This species yields very variable timber, the quality depending upon the conditions under which it is grown. When in forests it is considered valuable; when in fields usually not. It is a rapidly growing tree which often exceeds 150 feet in height and has about the same range as the Georgia pine. Its chief use is probably for fuel, though it is also cut for timber when grown under favorable conditions.

The Slash, Swamp, or Cuban Pine (*P. cubensis*).—This species is associated with the preceding and though used similarly is considered inferior to the Georgia pine.

Sugar Pine (*P. lambertiana*).— One of the most important timber trees of the Pacific Coast. It is indigenous from Oregon to Mexico, attains heights of 200 to 220 feet, diameters exceeding 10 feet and a large portion of its trunk is branchless. It is one of the tallest trees of the region and of its genus. Its timber is heavy, straight-grained, easily worked and is largely used for furniture and interior finish of houses. It bears edible nuts. Its name is derived from the sugar-like odor of its burning resin.

Bull, or Yellow Pine (*P. ponderosa*).— Perhaps second in importance to the preceding species in the West, its range being from British Columbia to Nebraska and southward to Texas and Mexico. It has several sub-species or varieties, which are of varied usefulness and application; those growing remote from the coast having coarser grained, harder and more fragile wood than those on the coast. Like the preceding it is one of the largest species of its genus and region, sometimes attaining a height of 230 and even 250 feet and a diameter of 10 feet but usually ranging from 100 to 150 feet with a diameter of about six feet.

Mountain White, or Silver Pine (*P. monticola*).—Another large species of the West, extending from British Columbia and Idaho to California, and attaining heights of 100 to 150 feet. It resembles the Eastern white pine somewhat in appearance.

Species of Inferior Importance.— The pinon, or nut pines (*P. monophylla, P. edulis* and *P. parryana*) are small trees in comparison with the foregoing, seldom attaining 50 feet. They are natives of the southwestern United States, where their wood is used as fuel and their large edible seeds as food. The Scotch pine (*P. sylvestris*) is the leading species of Europe, where it often forms extensive forests, frequently mixed with spruce fir, extending into northern and western Asia. Though usually less than 100 feet tall and about 30 inches in diameter, it sometimes attains 120 feet and a diameter of four feet. In its economic uses it resembles the Georgia pine, being good for ship-, bridge- and house-building, though there is considerable variation in the quality of the timber produced upon various soils and by various varieties. It also furnishes much turpentine, resin, etc., and its leaves are used for making pine wool and oil. The timber of the best grades is known as red pine or red deal. Corsican or black pine, or black fir (*P. laricio*), is a large native of southern Europe and western Asia, which is exceedingly rich in turpentine, etc., and supplies also some Burgundy pitch. Its wood is of little value except for fuel. The Aleppo pine (*P. halepensis*) is a native of the Mediterranean region and western Asia, and rarely exceeds 60 feet in height. It is useful for shore-planting, yields Venice turpentine, a liquid resin and a timber used in its eastern range for ship-building and similar purposes. The cluster pine or pinaster (*P. pinaster*) grows on the south European seaboard, and like the Corsican pine is used for shore-planting extensively in southern England along the coast. The Japanese red pine (*P. densiflora*) and Japanese black pine (*P. thunbergi*) are the two principal Japanese and North China species. They are used for many timber purposes and also for ornamental planting, having developed several horticultural varieties. The Cheer pine (*P. longifolia*) is a Himalayan species which often exceeds 100 feet in height and is valued for its timber, which is often substituted for European deal. Its resin is also obtained in commercial quantities. It has been introduced into California, where it is prized as one of the most decorative of pines, on account of its light, green, drooping leaves. Another Himalayan species, the Bhotan pine (*P. excelsa*), furnishes a close-grained durable wood which on account of its abundant resin is often used for torches. It is about the same size as the preceding species, and somewhat resembles the white pine of America.

Numerous other pines are more or less locally important, as the Philippine Island pine (*P. insularis*), which is one of the leading timber trees of the Philippine Islands, upon the high lands of which it forms large forests; the stone pine (*P. pinea*), one of the most picturesque trees of southern Europe and valued for its almond-flavored nuts and beautifully grained wood; Mexican pines (*P. montezumæ, P. ayacahuite* and *P. arizonica*), the first a white pine, the other two yellow; and the Cembra or Swiss pine (*P. cembra*), a species ranging from the Swiss Alps to northern Russia and Siberia, throughout which country it is valued for its nuts and its «Carpathian balsam.»

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PINE, Ground. See Lycopodiales, under Ferns and Fern Allies.

PINE, Running. See Lycopodiales, under Ferns and Fern Allies.

PINE BLUFF, Ark., city, county-seat of Jefferson County; on the Arkansas River, and on the Saint Louis, Iron Mountain and Southern and the Saint Louis Southwestern railroads, about 45 miles in direct line south by east of Little Rock. It is in an agricultural region in which cotton is one of the chief products. Its chief manufacturing establishments are cotton gins, cotton compressers, cottonseed-oil mills, foundry, furniture factory, saw-mills, automobile spokes, feed mills, printing establishments and boiler-sheet iron works, cotton, hides and poultry are shipped. The railroad shops of the Saint Louis Southwestern are located there. The annual fair under the auspices of the State Fair Association is held there. It is the seat of the State Colored Normal College, the Merrill Institute and a girl's industrial school, and it has public and parish schools and a public library. There is a free library connected with the Merrill Institute. Pop. 17,500.

PINE BLUFF (Ark.), **Engagement at.** Pine Bluff was held 25 Oct. 1863 by Col. Powell Clayton with a Union brigade consisting of the 5th Kansas and 1st Indiana Cavalry regiments, a company of State militia and seven field guns, in all about 575 men. Early in the morning of the 25th General Marmaduke with a division of about 2,500 Confederate cavalry and 12 guns approached the place and demanded its surrender. The outpost commander refused to permit the demand to be sent into headquarters and skirmishing began; the Union pickets being slowly driven in. Meanwhile Clayton, whose troops were quartered in the town, had set 300 negroes at work rolling cotton-bales out of the warehouses and barricading the streets leading into the public square. Artillery was put in position to sweep every avenue of approach; sharpshooters were posted in the buildings; and barrels were filled with water from the river to withstand a siege. The skirmishers were driven in about 8 o'clock and Marmaduke made an attack with his 12 guns and sharpshooters, but making no headway set fire to several buildings near the square to burn Clayton out. Failing in this, Marmaduke at 2 P.M. fell back, leaving some of his dead and wounded, and followed a mile by Clayton. He reported a loss of 40 killed and wounded. Clayton's loss was 11 killed and 27 wounded, and in addition several negroes were killed and wounded. The courthouse and several other buildings were burned and the town wrecked by the Confederate artillery fire. Consult ‘Official Records’ (Vol. XXII).

PINE FINCH, LINNET, or **SISKIN,** a small greenish finch (*Spinus pinus*), related to the goldfinch, whose home is in northern Canada, and which visits the northern United States in cold winters. These birds frequent coniferous trees and depend upon their seeds, buds, etc., for most of their food.

PINE GROSBEAK, a large northern finch (*Pinicola enucleator*), whose summer home is in northern Europe, Canada and the Rocky Mountains. It measures 9 to 10 inches in length. The head, fore-parts, neck and rump are bright red; back blackish brown, the feathers of this region having red edges; lower portion of the body light gray; wings and tail dusky. Like most winter visitors, it is very tame during the time when it is seen within the United States, which is irregularly in midwinter. Its food seems to consist principally of pine seeds, but it is also fond of those of the birch and alder, and occasionally descends to the ground, where it picks up the seeds of various plants, and probably a few insects. During late summer and winter it has a very pleasing song — clear, sweet and flowing, like that of the purple finch. Four or five eggs of a pale green color spotted with brown are produced; the nest, roughly built of sticks and lined with feathers, being placed on a branch of a tree near the ground. Consult Coues, 'Birds of the Northwest.'

PINE MARTEN, the American sable. See MARTEN; SABLE.

PINE MOUNTAIN, Engagement of. Gen. J. E. Johnston, commanding the Confederate army opposing General Sherman in the Atlanta campaign, abandoned his lines in front of New Hope Church 4 June 1864 and withdrew to a new position prepared by his engineer, running west from Brush Mountain to Pine Mountain and thence southwest to Lost Mountain. Pine Mountain, an isolated hill rising 300 feet above the surrounding country, formed a salient near the centre of this line. Upon Johnston's withdrawal Sherman occupied the railroad at and near Acworth, brought up supplies, was joined by General Blair, with two divisions of the 17th corps, and on the 10th moved his whole line forward and closed up on the Confederate position. By the 14th General Thomas, with a part of his line, had worked his way close to Pine Mountain, and during the day General Johnston, with Generals Hardee and Polk, two of his corps commanders, were on the mountains observing the movement, when some of Thomas' batteries opened upon the group, killing General Polk. During the night Johnston abandoned Pine Mountain, placing Bates' division, which had occupied it, in reserve, and on the morning of the 15th it was occupied by Howard's Fourth corps. Johnston still held the entrenchments connecting his principal line with Pine Mountain and other detached works, and at noon both Howard's and Hooker's corps advanced against these, Howard on the left of the mountain and Hooker on its right, driving the Confederates to their main works after a sharp engagement. Hooker then pushed against the principal line, Geary's division, supported by Williams', on the left, and Butterfield's division on the right. The Confederate resistance was very strong, and Hooker was repulsed with a loss of 639 killed and wounded. The Confederates, well covered by log breastworks, suffered but slightly. There was brisk and incessant skirmishing until the 18th, Sherman pressing closely and persistently at all points, and on the 19th Johnston was back on a new line, Hood's corps with its right on the Marietta and Canton road; Loring's (formerly Polk's) on the Kenesaw Mountain, and Hardee's on the left, extending across the Lost Mountain and Marietta road. (See KENESAW MOUNTAIN, BATTLE OF; KOLB'S FARM, ENGAGEMENT AT). Consult 'Official Records' (Vol. XXXVIII); Cox, 'Atlanta'; Sherman, 'Memoirs' (Vol. II); The Century Company's 'Battles and Leaders of the Civil War' (Vol. IV).

PINE MOUSE. See FIELD MICE.

PINE SISKIN. See PINE FINCH.

PINE SNAKE, or BULL SNAKE, a large colubrine serpent (*Pityophis melanoleucus*), prevalent in the pine-covered coast region from New Jersey southward, and locally called thunder and lightning snake and bull snake, the latter in reference to the loud hissing and bellowing noise it is able to make by reason of its peculiarly constructed glottis. It is pugnacious and malodorous, but harmless, and feeds on insects, mice, ground squirrels, eggs and young birds, etc., and lays its eggs in a shallow burrow in the sand. This serpent reaches a length of six feet, and is cream white, variously blotched with chocolate brown. Consult the writings of Holbrook, Cope, Abbott and Lockwood, and Ditmars, R. L., 'Reptile Book' (New York 1914).

PINE-TREE FLAG, an American colonial flag used in New England as early as 1700. It was at first red or blue with a pine-tree on a white field. Later it was all white with a pine-tree in the centre, and also the motto "An Appeal to Heaven." This flag was carried by the first war vessels used in the Revolution. See FLAG.

PINE-TREE SHILLING. See NUMISMATICS.

PINE-TREE STATE, a popular name applied to Maine, from the extensive pine forests covering a large part of the State.

PINEAL BODY, a small conical reddish body (frequently called pineal gland), ovoid and conical, an organ attached to the posterior cerebral commissure. It projects downward and backward between the anterior pair of the corpora quadrigemina. Its function was long questioned, the most favored theory being that it was a vestigial sense-organ, probably an eye. A hollow found in the parietal bone in many fossil mammals and reptiles was believed to have been the site of such an organ. This theory is now generally discarded, it having been demonstrated that there is a slight secretion by the body which is, therefore, classed as a gland. It appears to be connected with growth, both physical and mental. Consult McCord, C. P., 'The Pineal Gland in Relation to Somatic, Sexual and Mental Development' (Chicago 1914).

PINEAPPLE, a perennial herb (*Ananas sativus*) of the family *Bromeliaceæ*. It is a native of the American tropics, but has been introduced into warm climates throughout the world. It grows about three feet high, bears long, stiff, sword-shaped, brittle leaves in an elongated rosette, from the centre of which arises the fruit, surmounted by a crown of stiff leaves. After fruiting another stem may arise and bear a fruit, the process being repeated sometimes for 10 years or even more. The fruit vary from 4 to 10 inches or even more, and from 4 to 20 pounds, but the average weight is probably about eight pounds. Until the introduction of recent methods of rapid transit the pineapple was confined to warm countries, or to hothouses, in which large quantities were formerly grown. Very few are now cultivated under glass, but immense and annually increasing numbers are shipped from tropical and subtropical fields to the markets of cooler countries, and also are used for canning. The principal fields are the West Indies, Florida, northern Africa, Queensland, Hawaii and Azores Islands.

The pineapple thrives best in an equable climate where the temperature averages between 70° and 80°, and where dry and rainy seasons alternate. Whatever the soil it must be thoroughly drained, even dry. Depth is inconsequential; the plants produce well in the Florida Keys, where the soil is often only one or two inches deep above the coralline rock. They will withstand months of dry weather but quickly succumb to an excess of moisture, either in the air or the soil. Florida pineapple land frequently contains only a trace of the fertilizing elements considered essential; hence applications of plant-food must be liberal, care being taken to avoid an acid phosphate. Dried blood, nitrate of soda, ground bone, carbonate and sulphate of potash and cotton-seed meal are favorite fertilizers. The plants are never raised from seed except for the production of new varieties, since 10 years is often required to bring such plants into bearing. Rattoons, crowns, slips and suckers are used instead. Crowns, or the rosettes of leaves upon the fruits, are little used except when varieties are rare. Suckers develop from axillary buds near the ground and produce thrifty plants which usually bear before 18 months old; slips, taken from the base of the fruit, require fully a year longer to reach bearing age. Rattoons, which develop from buds beneath the ground and form a root-system of their own, are relied upon to a large extent to replace the plants that have borne. The land having been prepared, the plants are set in checks 18 to 36 inches apart, with alleys left at intervals of six or eight feet. Cultivation consists in keeping the surface loose with a scuffle hoe. With reasonable care a plantation should bear for 10 years without resetting. The fruits are gathered about a week before full maturity, wrapped individually in brown paper, packed firmly in half-barrel or barrel crates and shipped.

Pineapple sheds are built of slats upon a framework of posts and beams high enough to permit a man to stand upright under them. The slats are about three inches apart, to permit the ingress of light. The sheds protect the plants from excessive heat and from frost, and they improve the quality of the fruit. Only choice varieties are so grown, the cost of erection, about $500 an acre, being prohibitive of inferior sorts.

The principal enemies of the pineapple are red spider (*Stigmæus floridanus*); scale insects (*Diaspis bromeliæ*); and mealy bugs (*Dactylopius citri*, etc.). The first appears upon the tender leaf bases and causes rot. A handful of tobacco-dust placed in the crown of the plant is effective; rains dissolve and carry the solution to the infected parts. Resin wash, whale-oil soap and kerosene emulsion are used for the scale; these and the tobacco are used for the mealy bugs. The scale usually appears on the under surfaces of the leaves, but produces a yellow spot on the upper; the mealy bugs attack the bases of the leaves below ground, the buds and the fruit.

Blight or *wilt* is said to be due to a soil fungus at the roots. Removal and resetting are practised, though plants of valuable varieties are sometimes trimmed and replanted. *Sanding,* which follows the filling of crowns of young plants with sand, may be prevented by filling the crown after planting with cottonseed meal, or other loose material which will not prevent growth but will keep out the sand. *Spike,* non-expansion of the leaves, is due to unfavorable conditions of the soil. Change of fertilizer is recommended. *Heart rot* or *bitter heart,* which often accompanies wet seasons, is of unknown origin. The affected part, the heart, looks watery, and the whole fruit becomes bitter. If not serious in nearly mature fruits the pineapples may be marketed; otherwise destroyed. Consult Bailey, 'Cyclopedia of Standard Horticulture'; Rolfs, 'Pineapple Growing,' United States Department of Agriculture (Washington 1901); Rolfs, 'Pineapple Fertilizers,' Florida Experiment Station, Bulletin 50.

PINEAPPLE FIBRE. See FIBRE.

PINEAPPLE-MELON. See MELONS.

PINEDA, pē-nä'dä, Philippines, pueblo of Rizal, Luzón. See PASAY.

PINEHURST, pīn'hėrst, N. C., village in Moore County, 62 miles southwest of Raleigh and 125 miles from the seacoast. It is 650 feet above sea-level. The Pinehurst Electric Railroad connects with the Seaboard Air Line at Southern Pines. Railroad connection is made from Pinehurst over the Aberdeen and Asheboro Railroad with the Seaboard Air Line at Aberdeen and the Southern Railroad at High Point. Pinehurst is 18 hours' ride from New York City. It is a winter resort, founded in 1895 by James W. Tufts of Boston. It embraces a large tract of country, 150 acres of which has been beautifully laid out with croquet grounds, tennis courts, parks, etc. It includes a shooting preserve of 50,000 acres, a dairy and poultry farm and a large market garden. The location was selected for its scenery and healthfulness. Part of the year there is a population of about 2,500, at other times only 200 or 300.

PINEL, pē-nĕl, **Philippe,** French alienist: b. Saint André d'Alayrac, 20 April 1745; d. Paris, 26 Oct. 1826. He studied medicine in Toulouse, in Montpellier and in Paris, where he had to teach philosophy and mathematics to keep himself alive; in 1791 became directing physician in the insane asylum at Bicêtre and in 1794 at the Salpêtrière; and in both these institutions introduced gentle, kind treatment in place of the barbarities he found. In his book, 'Sur l'Alienation Mentale' (1791), he first suggested moral remedies for the insane, so that this work is the foundation of modern psychiatry. His 'Nosographie Philosophique' (1798) created an epoch in French medicine. He became a member of the Institute in 1803 on Cuvier's death. Suspected of liberal political views he was removed from his post in the medical school in 1823.

PINERO, pĭ-nĕr'ō, **Arthur Wing,** English dramatist: b. London, 24 May 1855. His ancestors, the Pinheiros, Portuguese Jews, settled in England in the 18th century. He was a solicitor's clerk for several years; went on the stage in 1874, appearing first in Edinburgh; became a member of Henry Irving's company soon afterward, playing Claudius in 'Hamlet'; and had written a farce, 'Two Can Play at that Game'; a successful comedietta, '£200 a Year'; the one-act plays, 'Daisy's Escape' and By-gones,' which were curtain-raisers for the Irving company at the Lyceum; and in 1881 'The Squire' and 'Imprudence' before turning himself in 1882 entirely to dramatic authorship. His earliest plays after that date show a striving after real characters — none too successful, for example, in 'The Magistrate' (1885). The beginning of his naturalistic power was to be seen not only in the well-known farces of the next two years, 'The Schoolmistress,' 'The Hobbyhorse' (1886), and 'Dandy Dick' (1887), but in the tragedy called 'The Weaker Sex,' first played in 1888. 'Sweet Lavender,' a pretty, rather unpleasant, very unreal and quite uncharacteristic play, was written in 1888. 'The Profligate,' with its Puritan theme of the impossibility of burying a wicked past, was dramatically powerful but poorly written. It was followed by the weak farces, 'The Cabinet Minister' and 'The Times,' in 1891 by 'Lady Bountiful,' and in 1893 by 'The Second Mrs. Tanqueray,' which showed great gain in literary ability and in dramatic machinery. Between them and 'The Notorious Mrs. Ebbsmith' (1895), no doubt his best play, came again a farce 'The Amazons'; indeed it seems that after every serious effort he returned to the farce. Pinero's later works are 'The Benefit of the Doubt' (1895), a triumph of theatrical construction; 'The Princess and the Butterfly' (1897), a charming combination of satire and romance; the graceful 'Trelawney of the Wells' (1898); a study in moral evolution, 'The Gay Lord Quex' (1899); the unpleasant but strong 'Iris' (1901); 'Letty' (1903); 'His House in Order' (1906); 'The Thunderbolt' (1908); 'Mid-Channel' (1909); 'Mind-the-Paint Girl' (1912). He was knighted in 1909. All in all, Pinero ranks as a master of the problem play. See THUNDERBOLT, THE.

PINEVILLE, Ky., city and county-seat of Bell County, on the Cumberland River and the Louisville and Nashville Railroad, 155 miles southeast of Lexington. It is an export centre for coal and lumber and has manufactures of coke and staves. Its principal points of interest are an Indian mound, the Continental Hospital and Sanitarium, the Mayne Johnson Seminary, courthouse, city hall and county infirmary. The city was first settled in 1868. Pop. 2,161.

PINEVILLE, La., town in the parish of Rapides, on the Red River and on the Chicago, Rock Island and Pacific, the Louisiana and Arkansas railroads, opposite Alexandria. The Louisiana Baptist College and the State Hospital for the Insane are located here. There is also a national cemetery. Farming and lumbering are the leading industries. The town owns the electric-lighting plant. Pop. 1,212.

PING PONG, or TABLE LAWN-TENNIS, a game that was introduced from England and became very popular in the United States in 1902. The game is played very much as is the regular game of lawn-tennis. Following are the rules of the game, which should be learned thoroughly before attempting to play:

First.— The game is for two people, one standing at one end of the table, the other opposite. The player who first delivers the ball is called the server, the other the striker out.

Second.— At the end of the first game the striker out becomes the server and the server becomes the striker out, and so on, alternately.

Third.— The service is strictly underhand, and delivered from beyond the end of the table.

Fourth.— The ball served must drop on the table top beyond the net, and is then in play. If it drops into the net or off the table it counts to the striker out.

Fifth.— In serving it is permissible for the ball to touch the net in passing over.

Sixth.— If the ball in play strikes any object above or around the table before it bounces on the table itself (net or post excepted) it counts against the player.

Seventh.— The server wins a stroke if the striker out fails to return the service or ball in play off the table.

Eighth.— The striker out wins a stroke if the server makes a foul or fails to return the ball in play so that it falls off the table.

Ninth.— No volleying is allowed, but so long as the ball touches the table it is in play and can be taken at half volley.

Tenth.— On either player winning his first stroke the score is called 15 for that player; on either player winning his second stroke the score is called 30; on either player winning his third stroke the score is called 40, and the fourth stroke won by either player is scored a game for that player, except as below.

Eleventh.— If both players have won three strokes (4) the score is called deuce, and the next stroke won is scored to the player. If the same player win the next stroke he wins the game; if he lose the next stroke the score is again called deuce, and so on until either player wins the two strokes immediately following the score of deuce, when the game is scored for that player.

Twelfth.— The player who first wins six games wins a set.

Thirteenth.— The game may also be scored by points, 20 up. In this case the players change the service every five points, as in cricket.

The game may be played on an ordinary dining table, about nine feet by five feet being the most convenient dimensions, though either a larger or a smaller table may be used. The net is between six and seven inches high, and the remaining accessories are posts to hold the net when stretched across the table; vellum, string or wood racquets and celluloid balls.

PING-YANG, pĭng yăng, Korea, a city on the Ta-tong River about 40 miles above its mouth and about 120 miles northwest of Seoul. It extends for two and a half miles along the river bank, is surrounded by fortified walls 20 feet high and is considered of great strategic importance, being called the "Key of Korea." Ping-Yang is open to foreign settlement, and is the seat of several Christian missions. There are about 10,000 Japanese here, they being most active in business. Ping-Yang is said to date from 1122 B.C., when the historic Ki-Tse or Kija, ancestor of Confucius, landed here from China, and laid the foundations of Korean civilization. His tomb is one of the city's sacred shrines. Among the important incidents of the city's history are the defeats of the Chinese here by the Japanese in 1593 and again on 16 Sept. 1894. A fine monument has been erected to the Chinese warrior Tso who ruled their forces and perished here. Pop., including suburbs about 173,273.

PINGREE, pĭn'grē, **Hazen Senter,** American politician: b. Denmark, Me., 3 Aug. 1842; d. London, England, 18 June 1901. He enlisted in the Union army and served through the war, afterward settling in Detroit, Mich., where he became one of the largest shoe manufacturers in the West. In 1889 he was elected mayor of Detroit and in 1896 gained control of the Republican political organization and notwithstanding the opposition to his radical ideas was elected governor. He continued to hold his office as mayor until 1897: he was elected governor of the State, and re-elected in 1898, retiring in 1900.

PINGUIN, the West Indian wild pineapple largely grown in the Antilles as a hedge-plant. See BROMELIA.

PINK-EYE, a disease of horses, frequently suffered in the Southern States, but rare in the North. It is allied to influenza and scarlet fever in man. It usually breaks out in wet, cold weather, and its chief symptoms are, besides the redness of the eye to which it owes its name, loss of appetite, feverishness, quickened pulse and perhaps stiffness of the limbs and constipation. It is likely to be epidemic in limited districts, because spread by the aid of the midges of the genus *Hippelates,* which hover about the eyes of diseased horses and carry pathogenic germs to the next animal they visit. It usually runs its course in 10 days or less, and is generally not fatal. In treating this disease an antiseptic wash for the eyes should be used; cardiac stimulants may be required and strict attention must be given to all sanitary care.

PINKERTON, ping'kėr-tŏn, **Allan,** Scottish-American detective: b. Glasgow, Scotland, 25 Aug. 1819; d. Chicago, Ill., 1 July 1884. In Scotland he had learned the trade of cooper and after his arrival in the United States set up a cooperage at Dundee, near Chicago. In 1842 he came to Chicago, Ill., and was appointed its first detective in 1850. In the same year he established a detective bureau, afterward well known from its use by predatory capitalistic interests to crush trades-unionism. He organized the secret service division of the United States army in 1861, was made its first chief and later formed and directed the secret service department of the Gulf until the end of the war. While employed by the Wilmington and Baltimore Railway he discovered a plot to assassinate Lincoln on the way to Washington (1861). He was very successful in his detective work, being particularly skilful in the detection of bank and express thieves and the recovery of the money taken. He also broke up the «Molly Maguire» band of Pennsylvania. Among his writings were 'The Spy of the Rebellion' (1883); 'Thirty Years a Detective' (1884); 'History and Evidence of the Passage of Abraham Lincoln from Harrisburgh, Pa., to Washington, D. C., on the 22d and 23d of February 1861' (1891); 'Strikers, Communists and Tramps' (1878), in which Pinkerton's lack of sympathy with the toiling masses is evidenced as also his unholy alliance and sympathy with the capitalists of his day. As manager and hirer of «strike-breakers» during the great railroad strikes of 1877 many of his methods were of questionable morality, although always strictly within the law, while many of his operations actually incited others to the crimes which were then «detected.» His writings are a sad commentary on the period which tolerated both him and his methods.

PINKERTON, John, Scottish antiquary: b. Edinburgh, 17 Feb. 1758; d. Paris, France, 10 March 1826. In 1781 he settled in London, where in 1783 he published 'Select Scottish Ballads,' a part of the supposedly ancient contents of which was from his own pen. He was for a time editor of the *Critical Review;* and he turned out a large number of volumes, original and compiled, the former showing more of skill in research than literary merit. Among works editorially prepared by him were 'Ancient Scottish Poems' (1786), sometimes declared to have been a forgery, though the manuscripts are in the Pepysian library at Cambridge; and a 'Collection of Voyages and Travels' (1807–14), a voluminous (17 vols.) and, in its day, valuable publication.

PINKERTON, William Allan, American detective: b. Dundee, Ill., 7 April 1846. He is a son of Allan Pinkerton (q.v.). During the Civil War period he was employed in the United States Secret Service and afterward entered his father's office. On the death of his father, in 1884, he became head of the agency and extended its operations throughout the world.

PINKNEY, pĭnk'ni, **William,** American diplomat: b. Annapolis, Md., 17 March 1764; d. Washington, D. C., 25 Dec. 1822. He was educated at King William's Seminary, studied law under Samuel Chase and was admitted to the bar in 1786. While a member of the Maryland legislature he assisted in the ratification of the Federal Constitution in 1788 and in the same year was elected to the house of delegates. As United States commissioner to England under the Jay Treaty he secured in 1796 a claim of $800,000 for the State of Maryland against the Bank of England for losses and damages to American merchants caused by the English government. Afterward he engaged in law practice in Baltimore and in 1804 became attorney-general of Maryland. In 1806 he was sent as Minister Extraordinary to England, where in conjunction with James Monroe he treated with England in regard to the latter's violation of the rights of neutrals. He was Resident Minister to England in 1807–11 and in the latter year was appointed Attorney-General of the United States. He fought in the War of 1812, served in Congress in 1815–16 and in 1816 was appointed Minister to Russia and Special Envoy to Naples. In 1818 he resigned and resumed his law practice in Baltimore and in 1820 was elected to the United States Senate. Consult Wheaton, 'Life, Writings and Speeches of William Pinkney' (1826).

PINKROOT, the rhizome of a loganaceous medicinal woodland (*Spigelia marilandica*) of the United States, which is bitter, anthelmintic, toxic, dilates the pupil, etc.

PINKS, a genus (*Dianthus*) of mostly perennial herbs of the order *Caryophyllaceæ.* The species, of which about 200 have been described, are natives of the Eastern hemisphere, especially Europe and western Asia. Their jointed stems, which grow in tufts, bear grass-like leaves and terminal, often fragrant, flowers either in clusters or solitary. Their popular name is derived from the prevailing color of the flowers, though white and purple are common in garden varieties. For centuries the pinks have been cultivated, their flowers, hardiness and ease of cultivation rendering them garden favorites. They are easily propagated from seeds or cuttings; thrive in well-drained, rather light loam; and the perennial kinds mulched during the winter with loose litter, straw or brush to prevent the formation of ice around the stems and to hold the snow and keep the frost in the ground until late in the spring. The seeds are usually sown under glass in early spring and the plants set in the garden when the weather has become settled. Cuttings are used for double and other choice varieties. Seeds sown in late summer will produce plants for early spring blossoming if mulched during the winter.

Among the best-known species are the following: Common grass, or garden, Scotch or pheasant's eye pink (*D. plumarius*), a general favorite in old-fashioned gardens; sweet-william (*D. barbatus*), one of the oldest and most popular of garden flowers; clove pink, picotee, grenadine or carnation (*D. caryophyllus*), popular in various forms either as a garden or a greenhouse plant (see CARNATION); maiden pink (*D. deltoides*), popular as an edging plant; *D. prolifer* and the Deptford pink (*D. armeria*), well-known weeds naturalized in the Eastern States; Chinese or Indian pink (*D. chinensis*) and *D. superbus*, also popular garden species. In rock gardens *D. alpinus*, *D. neglectus* and *D. glacialis* are favorites. They are too easily covered by earth washed upon them bv rains to be of value in level gardens.

PINNA, or WING-SHELL, a genus of bivalve mollusks of the family *Aviculidæ* with wedge-shaped shells of a horny, delicate structure, the hingeless beaks forming a pointed extremity. The foot is long and grooved and secretes a large byssus of strong, silky texture. The genus is represented by the *Pinna nobilis* of the Mediterranean Sea, from whose byssus in past days the Neapolitans, Sicilians and Maltese used to weave quantities of durable silk. Frequent mention is made of the fabric by Latin authors. Pope Benedict XV in 1754 had a pair of stockings made from this «silk.» Many other species are known in various parts of the world, including the shores of the Gulf of Mexico.

PINNACE. One of the boats of a man-of-war formerly used to carry the officers to and from the shore. It was smaller than the launch, but larger than the cutter, and was rowed by from 10 to 16 oars. Also, anciently, any small sailing craft.

PINNACLE, *in architecture*, any small, tall, more or less ornate terminating upper point of a building, tower, etc.; the topmost finishing piece of a high point, as on a gable, buttress or spire. The term pinnacle is not very definite, but it is used to describe miniature towers or tops of towers that are too conspicuous to be termed finials.

PINNATED GROUSE. See GROUSE.

PINNIPEDIA, a suborder of *Carnivora*, the seals, especially adapted in the structure of their limbs to an aquatic existence, as the name indicates. Both pairs of limbs, and especially their proximal segments, are very short, and the distal part flattened, webbed and paddle-like. The hind limbs are placed very far back and are very peculiar in that the first and fifth toes are stout and as long or longer, instead of shorter, than the others. The head is usually short and rounded, the neck short, the trunk thick and fusiform and the tail rudimentary. The teeth are simpler in structure than in most carnivora, the molars and premolars being either nearly simple cones or crowned with numerous small-pointed tubercles; the incisors are reduced in size and often in number, but the canines of the males are usually enlarged, and in the walruses become enormous tusks. The brain is large and much convoluted, and the eyes large and possessed of a very human expression. All of the pinnipeds spend the greater part of their lives in the water, swimming with great speed and dexterity; but the peculiar structure of their limbs ill adapts them for terrestrial progression, which is accomplished in an awkward shuffling manner with severe contortions of the back. They are chiefly marine, frequenting the coasts of colder climates, though some species are tropical and others enter fresh water. Some of the species spend much time far out at sea, but land on islands for the purpose of mating and bearing young. Most of them are carnivorous, feeding upon fishes, mollusks and crustaceans, but a few subsist in part upon marine algæ. The pinnipedia have been derived from land animals, probably from the bears, and their adaptation to an aquatic habitat is not nearly so extreme as in the whales. Three families are usually recognized: The *Otariidæ*, or eared seals, which have a small, valvular, external ear and include the sea-lions and sea-bears. The *Phocidæ* have no external ear, and are the most completely aquatic members of the suborder. Here belong the common harbor-seal of the north Atlantic coast, the hooded seal, the sea-elephant and numerous other species. In the *Trichechidæ* is included only the walrus, in many respects the most remarkable of the entire group. Consult Allen, J. A., 'History of North American Pinnipeds' (1880). See SEALS; ELEPHANT-SEAL; WALRUS.

PINOCHLE, pē'nō-kl (corruption of Binocle).

PINOCLE, or PENUCHLE, a game of cards very popular among the Germans in America. The object of the game, which may be joined in by either two, three, or four persons, is to secure 1,000 points. The game is played with two full packs of cards, mixed, from which the twos, threes, fours, fives, sixes, sevens and eights have been removed. In 64-card pinocle the sevens and eights are retained. This is the schedule of «points»:

Eight aces count	1,000
Eight kings count	800
Eight queens count	600
Eight jacks count	400
Two queens of spades and two jacks of diamonds (double penuchle) count	300
Ace, ten, king, queen and jack of trumps count	150
Four aces of different suits count	100
Four kings of different suits count	80
Four queens of different suits count	60
Four jacks of different suits count	40
Queen of spades and jack of diamonds (penuchle) count	40
King and queen of trumps (royal marriage) count	40
King and queen of a suit not trumps (marriage) count	20
Nine-spot of trumps counts	10

The relative value of the cards is: Ace counts for 11 points, 10-spot counts for 10 points, king for four, queen for three, jack for two and the nine counts nothing. The last trick counts 10 points for the player who takes it. The total points, therefore, of the cards and last trick combined amount to 250. Four-handed pinocle is usually played two against two as partners, sitting opposite one another. The cards are all dealt out, four at a time, each played receiving 12, and the last card is turned up for trump. If two are playing, the 25th card is trump. If a nine is turned up the dealer is credited at once with 10 points; if any other card is turned up either of the other players who holds a nine of trumps may exchange it for the trump card and claim 10 points, the player sitting on the left-hand side of the dealer having the preference. Each player then melds whatever he has in his hand and the partners score together. The eldest hand then leads a card for the first trick. In every trick each player must follow suit; if he cannot he must trump; if neither is possible, he may play any card he pleases; he must take the trick if he can; the player who takes the trick leads for the next. When either side reaches 1,000 points the scorer calls «game,» and the balance of the hands are void. In three-handed pinocle 16 cards go to each player, four at a time; and each player keeps his own score. In auction pinocle no trump is turned, each player in turn from the dealer's left bidding a number of points for the privilege of naming the trump. If all the players pass this privilege the dealer is obliged to bid 20 and name the trump. Consult Foster, R. F., 'The Laws of Pinocle' (New York 1908).

PINOS, pē'nōs, Mexico, town in the state of Zacatecas, 45 miles west of San Luis Potosi, and capital of the administrative district of Pinos. It is about 7,700 feet above the sea-level, lying on the eastern slope of the Cerro de Candelaria; is centre of a rich silver and gold-mining district, and produces an excellent grade of mescal. The population of the district is estimated at 50,000; of the town, 7,500.

PINSUTI, pēn-soo'tē, **Ciro**, Italian composer: b. near Siena, 9 May 1829; d. Florence, 10 March 1888. He was trained as a musician by his father and by Rossini; became a singing teacher in London and Newcastle in 1848 and professor of singing in the English Royal Academy of Music in 1856. He wrote the successful Italian operas 'Il mercante di Venezia' (1873); 'Mattia Corvino' (1877), and 'Margherita' (1882); as well as a 'Te Deum' (1859), on the annexation of Tuscany to Italy, and several fine songs.

PINT, a measure of capacity, the eighth part of a gallon. See WEIGHTS AND MEASURES.

PINTAIL, or **SPRIGTAIL DUCK**. See DUCK.

PINTO, pēn'tō, **Alexandre Alberto da Rocha Serpa**, Portuguese explorer in Africa: b. Castle Polchras, 10 April 1846; d. Lisbon, 28 Dec. 1900. He was educated in America, where he lived with his father, 1848–58, and then in the Lisbon Military College, whence he entered the Portuguese army in 1864. He served in Mozambique and in 1877–79 explored the country between Mozambique and Pretoria, in 1885 the region west of Lake Nyanza, and in 1889, having been named governor of Mozambique, the region round the Shire River. His bold attitude toward English expansion in Africa and his efforts to spread Portuguese influence made his recall necessary in 1890 because of a protest from England. His trip across Africa in 1877–79, the fourth crossing from west to east, was his greatest feat and is described in his book 'How I Crossed Africa' (1881).

PINTO, Fernao Mendez. See MENDEZ PINTO.

PINTSCH (pinch) **SYSTEM**, a system of compressed gas chiefly used for lighting railroad cars. Nearly every large railroad system in the United States has adopted this system. The gas is made largely from oil and compressed, 125 pounds of pressure to the square inch giving one foot of oil gas, equal to the illuminating power of five feet of coal gas. Petroleum oil is «cracked» at a high temperature, yielding an oil gas rich in illuminating power; by washing the forming of tar is obviated. The lamps used are of special design, each having from four to six burners. The system has been applied to lighting harbor buoys and found advantageous.

PINTURICCHIO, pēn-too-rēk'kē-ō («the good little painter»), easel name of Bernardino de Betto Bagio, Italian painter: b. Perugia, 1454; d. Siena, 11 Dec. 1513. It is thought that he was a fellow-student of Pietro Perugino under Niccolo da Foligno, and he was assisting Perugino (his senior by only eight years), at Rome (1484) in executing the frescoes of the Sistine Chapel for Innocent VIII. Among his other Roman patrons were Sciarra Colonna and Alexander VI; for the latter he painted a series of scenes from the life of Saint Bernard in the church of Ara Cœli, and five frescoes in the Vatican. He returned to Umbria in 1498 and works of his are extant in Perugia, Orvieto and Spoleto. Cardinal Francesco Piccolomini, afterward Pius III, on completing his cathedral at Siena, invited him to decorate the library of that building (1502). The walls he frescoed with scenes from the life of Pius II, the cardinal's uncle, and the roof with arabesques and mythological compositions. Raphael, then 19, accompanied him to Siena, but whether he took part in the execution of the frescoes is uncertain. These works are brilliant in conception and execution and are considered the finest of his frescoes. Fresco-painting was indeed his strongest point; he understood well the decorative resources of his art, and was master of ornament. He left few easel pictures and these are scattered through the chief public and private galleries of Europe. His 'Return of Ulysses' was sold in 1874 for $10,761.50, and his three scenes from the life of Griselda for $3,620. The last of his known works, painted in 1513, is the 'Procession to Calvary,' now in the Casa Borromeo, at Milan. Sigismodo Tizio, parish priest at Siena, has left a true but tragic account of his death. When confined by sickness to his bedroom his wife locked him in, went off with her lover and left her husband to perish by hunger. In the history of painting he is to be looked upon as the link between Perugino and Raphael and some pictures of his have been attributed to each of these masters. He bore a high character among his fellow-citizens and was elected decemvir of Perugia in 1501.

PINWORM, a small parasitic nematode worm (*Oxyurus vermicularis*), usually less than half an inch in length, which infects the human rectum and large intestine, especially in children. Pinworms travel down the bowel and cause irritation about the anus, which provokes the victim to scratching. The eating of fruit, etc., handled by one suffering from pinworms is a probable means of infecting another.

PINY RESIN, TALLOW, or **VARNISH**. See DAMMAR.

PINZON, pēn-thōn', **Martin Alonzo**, Spanish shipbuilder and navigator: b. about 1440; d. 1493. He was a native of Palos, and at the summons of Prior Juan Perez of La Rábida held a conference with Columbus (q.v.) and decided to aid the latter in his first voyage.

In this expedition he sailed in command of the *Pinta*, the second caravel, but deserted Columbus off the coast of Cuba 20 Nov. 1492. The *Pinta* was the fleetest of the three vessels, and the purpose of Pinzon's treachery was evidently that he might first reach Spain and there make exaggerated claims for himself. He was the first to reach Haiti (Hispaniola), where he traded and found gold, and where when he fell in with Columbus, 6 Jan. 1493, he explained that stress of weather had separated him from the other ships. In a fierce storm during the return (12–18 Feb. 1493), the *Niña* and *Pinta* were parted, and the *Pinta* reached Bayonne, a Galician port. Thence Pinzon dispatched to the sovereigns an account of the discovery, claiming much. But this was quite disregarded, and when he reached Palos it was only to find the admiral already there. A letter from the monarchs forbade him to appear at court, and it was said that chagrin hastened his death.

PINZON, Vincente Yañez, Spanish shipbuilder and navigator: b. about 1450; d. about 1525. He was a brother of Martin Alonso Pinzon (q.v.) and a native of Palos, and set sail from there on Columbus' first voyage as commander of the third caravel, the *Niña*. But he is better known for a voyage he undertook in 1500, during the course of which he discovered the Brazilian coast and the mouth of the Amazon. He made with Juan Diaz de Solis two voyages, one probably in 1497 to the bay of Honduras, the other in 1508–09 along the eastern coast of South America as far as the Colorado River, lat. 40° S.

PIOLET, pē'ō-lā, **Jean-Baptiste,** French clergyman and author: b. Courteix, Corrèze, France, 24 June 1855. He was educated at the college of Ussel and the seminaries of Servières and Tulle and various Jesuit scholasticates. In 1876 he became a member of the Society of Jesus and was ordained to the priesthood in 1888. In 1890–91 he was laboring as missionary in Madagascar and in 1898 delivered a course of lectures on Madagascar at the Sorbonne. Subsequently Dr. Piolet was missionary in Wales and at Paray-le-Monial, and for some years has been stationed in Paris. He was awarded three prizes by the French Academy and the Academy of Moral Sciences and has attended various colonial congresses and the sessions of the International Colonial Institute. His publications include ‹Le catholicisme en Indo-Chine›; ‹La religion catholique en Chine›; ‹L'Eglise catholique aux Index›; ‹Madagascar, sa description, ses habitants› (1895); Madagascar et les Hova› (1895); ‹Empire colonial de la France: Madagascar›; ‹Douze leçons sur Madagascar› (1898); ‹De notre emigration›; ‹L'Eglise catholique dans le continent noir,› with C. Vadot; ‹Nos missions et nos missionaires; ‹Questions d'Angleterre› (1906). He organized and directed ‹Les missions catholiques Françaises au XIXe siècle› (6 vols.), and contributed to *Etudes, Le Correspondant, La Revue Hebdomadaire,* etc.

PIOMBINO, pē-ŏm-bē'nō, Italy, (1) a former principality of Tuscany, lying between Siena and the Mediterranean, opposite the island of Elba, from which it is separated by the channel of Piombino. Its extent was about 216 square miles, with a population of 25,000 at the time of its incorporation with the kingdom of Italy (1860). It was originally a fief in the possession of the Appiani family, which, after a rule extending over 300 years, sold it to the Buoncampagni family in 1634. In 1804 Napoleon granted it to his sister Eliza, Princess Baciocchi; but she was rejected by the Congress of Vienna, and the old family restored. Piombino now forms part of the province of Pisa. (2) A seaport town of Pisa, 40 miles south-southeast of Leghorn, at the end of Monte Massoncello peninsula. Elba is visible six miles across the channel. Pop. with commune about 8,700.

PIOMBO, pē-ŏm'bō, **Sebastiano del,** Italian painter: b. Venice, 1485; d. Rome, 21 June 1547. His family name was Luciani. Having renounced music, to which he had early devoted himself, for painting, he studied under Giovanni Bellini and Giorgione, the latter of whom he especially imitated. Something of the fine coloring of Giorgione appears in the figure of Saint Chrysostom writing, in the altarpiece of the church of that name at Venice, which is Piombo's earliest fresco. In 1510 he went to Rome and became acquainted with Michelangelo, whose mastery of form he tried to make his own and to combine with his own Venetian skill in coloring. He also vied with Raphael, and the so-called ‹Fornarina› in the Uffizi and the ‹Saint Dorothea› at Berlin were both for a long time attributed to Raphael. When Raphael had painted his ‹Ascension,› Sebastiano was induced by Michelangelo to attempt to surpass it by the ‹Raising of Lazarus,› considered his greatest work. His ‹Martyrdom of Saint Agatha› also ranks among the masterpieces of the Italian school. His chief merit, however, lay in single figures and portraits. His ‹Pietro Aretino› and his ‹Clement VII› are admirable likenesses and perfect in coloring. He was high in favor with Clement: who created him one of the keepers of the Papal seals, *Frate del Piombo;* hence his surname, the seals attached to the papal bulls being at that time of lead (*piombo*). This post made it necessary for him to assume the clerical habit, and from that time he painted but little. He invented a peculiar method of painting in oil on walls, in which manner there is a ‹Scourging of Christ› to be seen in Saint Pietro in Montorio.

PIONEERS, in old-time warfare, a detachment of soldiers equipped with pickax, spade, etc., in the proportion of 10 to every battalion of infantry, whose duty it was to clear and repair roads, bridges, etc., as far as possible, for troops on the march. They were placed at the head of the battalion of which they form a part and commanded by a pioneer sergeant. They have long been replaced by the engineer corps. However, the engineers are sometimes termed the «pioneer battalion.»

PIOTRKOW, pēy-ŏtr'kŏv, Russian Poland, (1) the capital of a government of the same name, 90 miles by rail southwest of Warsaw. Cotton and wool spinning, with the manufacture of agricultural implements, are the chief industries. The town dates from before the 12th century and is one of the oldest in Poland. In its ancient castle still standing, diets were held in the 15th and 16th centuries and the kings elected. After being captured by the

German army in 1915, the fortifications were strengthened. Pop. about 41,181. (2) The government in the west of Russian Poland, south of the government of Warsaw, has an area of 4,730 square miles. The surface is undulating and diversified by hills from 1,000 to 1,600 feet high, extending southwest to northeast. It is rich in coal deposits and iron, zinc and lignite are also mined. Agriculture and stock-raising are important industries and there are manufactures of textiles and ironware. Pop. 2,097,900.

PIOUS FUND OF CALIFORNIA, an endowment fund dating from 1697 and created from voluntary donations and subscriptions received or solicited from various benefactors and religious bodies, chiefly in Mexico, to be applied to the propagation of the Catholic faith in California. The first chief contributors who each gave $1,000 were Don Alonzo Davalos, Condé de Miravalles and Don Mateo Fernandez de la Cruz, Marquez de Buena Vista. By their example others were induced to subscribe and in a short time $15,000 more were made up, $5,000 in cash and $10,000 in promises. On 5 Feb. 1697 the necessary authority was conferred on Fathers Juan Maria Salvatierra and Francisco Eusebio Kino of the Jesuit order, to undertake the invasion of California on the express conditions: 1. That possession of the country was to be taken in the name of the Spanish crown, and 2. That the royal treasury was not to be called on for any of the expenses of the enterprise. Don Pedro Gilde la Sierpe, treasurer of Acapulco, offered the use of a galliot to transport the missionaries to their destination, and the gift of a small boat or launch. Considering the remoteness and isolation of the field, it was determined to establish a separate special fund or capital, the income from which should form a permanent endowment for the missionary church. Toward this latter object the first recorded contribution is from the congregation of Nuesah Signora de los Dolores, of the city of Mexico, which contributed $10,000 and Don Juan Caballero y Ozio who donated $20,000 more, besides giving Father Salvatierra the satisfactory assurance, that in any unforeseen emergency, he might draw on him for whatever money he needed and he would honor his drafts, large or small. This endowment fund, commenced by the pious liberality of the society and the individual just named, was increased by subsequent donations. The capital was invested as securely as possible, and as an income of $500 yearly was deemed necessary for each mission and 5 per cent was the current rate on safe investments, a capital of $10,000 was made the basis of each new mission founded. From 1698 to 1757 13 missions were founded on the peninsula and these sums of money forming a considerable capital, received by common consent the name of «The Pious Fund of the Missions of California,» or more briefly, the «Pious Fund of California.» In 1767 the Jesuits were expelled from the Spanish dominions; the Pious Fund was seized by the Crown and transferred to the Franciscans under whom from 1769 to 1823 the 21 missions in upper California were founded. On the declaration of Mexican independence, Mexico succeeded the Crown of Spain as trustee of the Pious Fund and it continued to be managed and its income applied as before, down to 19 Sept. 1836, when the Mexican Congress passed a law attaching an endowment of $6,000 per year for the erection of a bishopric and conceded to the incumbent when selected and his successors, the administration and disposal of the «Pious Fund.» On 8 Feb. 1842 this law was abrogated by a decree of Santa Ana and the capital of the Pious Fund after about 160 years of separate existence «was engulfed in the maelstrom of the Mexican treasury.» Not, however, before Don Pedro Ramirez, the venerable agent and attorney of the fund, had drawn up in duplicate his detailed «instruccion circunstanciada» of the properties, and the Mexican government had stipulated to pay to the Church 6 per cent in perpetuity on the principal. The war of 1847 between the United States and Mexico resulted in the transfer of Upper California, and Mexico ceased paying interest. In 1868 the Roman Catholic Church in California made a claim, based on Don Pedro's data for 21 years' interest — nearly a million dollars — and after seven years a commission at Washington, D. C., gave a decision that the interest of the fund should be equally divided between the Church in Mexico and in California and that Mexico should set aside half of the annual payment. This was the famous Sir Edward Thornton decision. The Mexican government paid the award decreed by Sir Edward, but did not pay anything after. In 1902 the matter was brought before the Hague International Court for arbitration. The decision was given: that the Mexican government shall pay to the government of the United States in the claim on behalf of the archbishop of San Francisco, $1,420,682.67 in money of the legal currency of Mexico, a sum covering the total payment of annuities due from Mexico, namely, the annual payment of $43,059.99, and that the Mexican government shall pay to the United States on 2 Feb. 1903 and every following year of the same date forever, an annual payment of $43,059.99. Consult Doyle, T. T., ‘History of the Pious Fund of California’ (San Francisco 1887).

PIOZZI, pĭ-ŏz'ī (Ital. pē-ŏt'sē), **Hester Lynch Salisbury,** English author: b. Bodvel, Carnarvonshire, Wales, 16 Jan. 1741; d. Clifton, Gloucestershire, 2 May 1821. In 1763 she was married to Henry Thrale, a wealthy brewer of Southwark, which borough he afterward represented in Parliament. In 1764 the Thrales made the acquaintance of Dr. Johnson, who lived much with them for more than 16 years and of whom she published ‘Anecdotes’ in 1786. Thrale dying in 1781, his widow married in 1784 Gabriel Piozzi, a Florentine music master, then resident in Bath. This alliance annoyed her friends and Johnson gave up her society. She accompanied her husband to Florence and while there contributed several poems to the *Florence Miscellany*, founded by the leaders of the Della Cruscan School, much ridiculed by Gifford. Among her writings are ‘British Synonym, or an Attempt at regulating the Choice of Words in Familiar Conversation’ (1794); ‘Retrospection, or a Review of the most Striking Events and Characters of the last 1,800 Years’ (1801). Consult ‘Autobiography, Letters and Literary Remains’ (1861); Seeley, ‘Mrs. Thrale’ (1891); Countess Cæsaresco, ‘Glimpses of Italian Society in the 18th Century' (1892); Boswell, 'Life of Samuel Johnson' (1791).

PIP. See POULTRY.

PIPA. See SURINAM TOAD.

PIPE, a wine measure, usually containing very nearly 105 imperial or 126 wine gallons. Two pipes or 210 imperial gallons make a tun. In practice, however, the size of the pipe varies according to the kind of wine it contains. Thus, a pipe of port contains 138 wine gallons; of sherry, 130; of Madeira, 100, etc. The pipe of port is seldom accurately 138 gallons and it is customary to charge what the vessel actually contains.

PIPE, Manufacture of. Pipes are hollow cylinders made of various materials and used as conduits for liquids, air or gas. The material of construction varies according to the character of the substance to be conveyed, its availability in any particular locality and its relative cheapness. They may be divided into five general classes characterized by the materials of which they are made — metal, wood, earthenware, cement and rubber. Metal pipes are made of lead, block-tin, zinc, brass, copper, cast iron, wrought iron and steel. Lead pipes have been used from the earliest times. Up to the close of the 15th century, they were made of sheet lead bent around a metal core and welded or soldered along the horizontal joint. About the beginning of the 16th century, a casting method was invented by Robert Brooke, which was extensively employed in England up to the close of the 18th century, when it was superseded by the pressing and drawing methods in use at the present time. They are made in continuous length, by squeezing the molten metal through a die (a steel plate perforated with a hole containing a central core) by hydraulic pressure. Different sizes of pipes are produced by changing the dies, the cores of the dies determining the diameter of the bores. Sizes of pipes are designated according to the measurement of their internal diameters. Lead water-pipes range from three-eighths to five inches, while the waste pipes range from one and one-half to five inches. Lead pipes as small as one-sixteenth of an inch and as large as eight inches are made for various purposes. The high cost of lead and the great thickness of metal required to withstand high presspres practically prohibit the production of the larger sizes. Pipes of ductile metal, such as block-tin, brass and copper, are made by drawing methods. An ingot of metal is cast in cylindrical shape with a conical end and with a hole through its axis corresponding in size to the bore of the desired pipe. A mandrel (long iron rod) is thrust into the hole so that it projects slightly beyond the conical end. This end is then placed in a funnel-shaped hole drilled through a steel post fixed to the drawing table and gripped at the outer end by a pair of pincers at the end of a chain attached to the power machinery. The ingot together with the mandrel is then drawn through the hole, the former being thus extended uniformly over the latter in the form of a complete pipe. Unlike the pressure method, the metal is drawn cold and often requires annealing, as it hardens under the repeated drawings. Block-tin pipes are used in soda fountains and as conveyors of beer and chemicals. Copper pipes are used in distilleries, and when employed in chemical works are tin-plated within to protect them from corrosion. Brass is generally used for pipes exposed to great heat, such as the tubes of steam boilers, etc. Block-tin pipes range from three-eighths to two and one-half inches in diameter.

Cast-iron Pipe.— In making cast-iron pipes, the mold used consists of two parts — the core which shapes the interior and the flask which holds the pattern for the exterior form. The core is made by winding a hay-rope around a spindle and coating it with several layers of clay. It is then shaped in a lathe to the desired size and dried in an oven. Tempered clay and sand are rammed around the pattern in the flask and then dried in an oven to form a mold. The pattern is then removed, the flask is placed in a vertical position and the core exactly central within it. The molten metal is run into the space between the mold and the core and, when partly cooled, the core is drawn out and the interior of the pipe is coated with asphaltum to prevent corrosion. In size they range from two to 60 inches and are made in standard lengths of 12 feet. The larger pipes are generally cast in shorter lengths in order to keep down the weight of the individual pipes so as to permit convenient handling. They are used for water mains, pneumatic tubes, exterior casings for other tubes and pipes, etc.

Wrought-iron Pipe.— Wrought-iron pipes appear to have been first employed to convey illuminating gas, and this remains one of the most common uses, the carrying of steam and water being others. At first they were made by hand, the plates being bent and the seams welded, a few inches at a time. The development of steam engineering, however, created a demand for larger and stronger pipes, in the production of which new processes of manufacture employing special machinery have been introduced and developed to a high state of perfection. The wrought-iron pipe and tube industry was one of the last to discard puddled iron in favor of Bessemer steel. The advantages of increased strength and lower cost, to be obtained by the use of steel, had been fully realized for some time, but the difficulty of making lap-welded and butt-welded steel pipes, having the same strength in the weld as in the body of the pipe, prevented its adoption.

Methods of Manufacture.— These difficulties, however, have been overcome by improved methods of production in materials and machinery in pipe making. The general process of manufacture is as follows: A carefully selected grade of cast iron, together with the proper quantities of coke and limestone, are melted down in the cupolas of a blast furnace, drawn off and placed in the Bessemer converters, where it is heated until practically all of the carbon in the cast iron has been burned out. The metal is then poured into casting ladles, into which an amount of ferromanganese is also added, sufficient to give the proper proportion of manganese and carbon. The resulting metal is a mild steel of a very reliable welding quality. The cast ingots are then placed in the soaking pit and raised to a white heat. From the soaking pit they are picked out by overhead cranes and rolled down into the blooms of the blooming mill. This mill is of massive construction and is driven by horizontal reversing engines. It consists of a set of reversible mill rolls, with a long table of rollers on each side. The action of the rollers draws the ingot quickly into the rolls and as soon as it has passed through, the engines are reversed, the rolls are brought a little closer together by a pair of screws set in the standards and the ingot is again reduced in thickness. This operation is repeated until it has been brought down to the desired section, when it is sheared into short lengths, called slabs and billets. These are reheated and passed through a continuous mill, consisting of a large number of rolls in pairs, placed one beyond the other at increasing intervals. As the billets or slabs are carried through each successive pair of rolls, they are reduced in thickness and increased in length, until they issue from the last pair of rolls in the form of long narrow plates, known as skelp. They vary in width from a few inches up to eight feet. In the narrower strips, used for smaller pipes, the width is sufficiently uniform to dispense with the necessity of trimming up with shears, but the skelp for large pipes has to be carefully trimmed to the right dimensions. In general, all wrought-iron or steel pipes may be divided into two classes — lap-welded, ranging from 1½ to 30 inches and butt-welded, from one-third to one and one-fourth inches in diameter. In lap-welding, the plate is first laid upon a traveling table and has its edges scarfed or beveled. It is then heated in a bending furnace and rolled up into the form of a pipe, with the beveled edges overlapping. This partially made pipe (known also as skelp) is brought up to a welding heat in a furnace and then passed through the concave welding rolls between which a ball-shaped mandrel, the diameter of which is equal to that of the pipe, is held in position by a long bar. As the skelp passes through the rolls, the overlapping edges are squeezed together between the rolls and the mandrel into a more or less perfect weld. The rough pipe is then passed through the sizing rolls and brought to the exact diameter required; then through the cross-straightening rolls and made perfectly straight; then rolled on a cooling table while cooling, to prevent warping and finally forced through the dies of the straightening machine by hydraulic pressure. The ends are then trimmed and threaded and after being screwed into the couplings, it is tested in a hydraulic testing machine. The smaller sizes under pressures ranging from 600 to 1,500 pounds and the larger sizes from 500 to 750 pounds to the square inch. Oil-well piping is tested under pressures as high as 2,500 pounds to the square inch. In butt-welding, the edges of the plate are left square. The skelp is heated in a furnace and raised to a welding heat. It is then drawn through a bell-shaped die, the diameter of which is a little less than that of the skelp. The pressure thus induced squeezes the edges together and makes a perfect weld. The smaller pipes are usually fitted with screwed flanges and couplings. In the larger pipes the flange is formed out of a bar of steel, bored out and faced on the inner face, a half-inch fillet being left on the inner edge. The end of the pipe is swaged down slightly, the flange pushed over it and the edge of the pipe beaded over to hold the flange in place while it is in the furnace. When it has reached a welding heat, it is placed on a concave anvil, stepped to receive both pipe and flange and revolved axially under the blows of the hammer which quickly effect a weld. Flanges have been welded on pipes over 30 inches in diameter, with satisfactory results.

Coupling.— Pipe couplings are made from bars of iron corresponding to the width and thickness of the desired coupling. The smaller sizes are made by a machine which cuts up the bar into the proper lengths and forms up the pieces on a mandrel with great rapidity. These pieces are then heated in a welding furnace and welded under the blows of a quick-acting steam hammer. The larger sizes are made from bar iron of the proper length, which is formed up by a machine consisting of a vertical cylindrical mandrel of a diameter equal to that of the desired coupling. A vertical roller attached to the end of a horizontal arm travels around the mandrel. One end of the heated bar is placed between the mandrel and the roller; the roller is then revolved around the mandrel and bends the bar into the required circular form. The piece is then reheated, slipped over a cylindrical mandrel and the joint welded under the blows of a quick-acting steam hammer.

Varieties.— Spiral-riveted and spiral-welded pipes are made by winding thin iron plates spirally around a mandrel into tubular forms, and the overlapping edges riveted or welded together. They are made in standard lengths of 20 feet and range from 3 to 24 inches in diameter. The metal plates used range from .035 to .109 inch in thickness. They are capable of withstanding bursting pressures up to 1,330 pounds to the square inch.

The locking-bar pipes are made of two semicircular plates of metal joined together longitudinally by a channel bar of soft steel, the flanges of which are pressed into the edges of the plates until a tight joint is effected. The earliest forms of wood pipes were simply bored logs. Their first use as a continuous tube was the six-foot penstock built at Manchester, N. H., in 1874, by J. T. Fanning. The use of metal bands around wood-stave pipes was first suggested in 1880 and were first extensively used in Denver, Colo., in 1883. This particular kind of pipe is built in a trench. The staves are of different lengths, which allows continuous construction. They are bound together by light metal rods or bands provided with screw ends and nuts for tightening. These rods are spaced on the pipe according to the amount of internal pressure they are expected to withstand. The staves used are thin enough to secure complete saturation and to deflect readily to the curvature employed; yet, thick enough to prevent an undesirable amount of percolation through them. The proportion between the thickness of the staves and the strength of the bands is such that the swelling of the wood does not produce injurious strains upon the bands. Such pipes or conduits range from 10 to 72 inches in diameter; are capable of withstanding pressures as high as 1,100 pounds to the square inch, and have done service, in the United States, for periods ranging from 20 to 50 years, without any material deterioration.

Fibre Pipe.— Fibre pipes are made by winding sheets of wood pulp around a core. The desired thickness being obtained, the tubes are saturated with a wood preserving solution and dried. The joints at the ends are turned in a lathe and they are provided with screw couplings. They may be made in any size or thickness, but usually range from one to eight inches in diameter, with a uniform length of five feet. Being made of a non-corrosive material, they are especially useful for conveying chemicals.

Clay Pipe.— Earthenware or terra-cotta pipes are represented by the various forms of drain tiles, designedly made porous or vitrified, and with or without joint sockets, according to the purposes for which they are used. They were first made in England about the close of the 18th century and were mere cylinders of porous baked clay. In recent years their manufacture has attained the proportions of a great industry. They are produced by forcing prepared plastic clay through a die into the form of a continuous tube, which is subsequently cut up into shorter lengths and the joint sockets molded by a special machine. They are then baked in kilns by a very high temperature. The vitrified variety are glazed by the introduction of salt into the fire holes of the kilns while the pipes are being baked, so that the salt is volatilized and combines with the silica in the clay. They range from 1½ to 36 inches in diameter and from one to three feet in length. Pipes are also made of cement and concrete. They are usually molded in place by the use of a movable mold and core, which is shifted along the work or by stationary built-up molds, which are torn out after the cement has set. Wire nettings and iron rods are often inserted in the cement to give additional strength.

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PIPE, Tobacco, a bowl and connecting tube, made of baked clay, wood, stone or other material and used in smoking tobacco. The cheap pipes in common use are made of a fine-grained white plastic clay. Much finer and more expensive pipes are made of meerschaum, a somewhat plastic magnesian stone of a soft greasy feel. (See MEERSCHAUM). This material is found in several parts of Europe (in Moravia, Piedmont and the Crimea), but more abundantly and of finer quality in Asia Minor. Meerschaum pipe making is carried on to the greatest extent by the Germans, and Vienna may be said to be the centre of the manufacture. Sometimes the bowl alone (which is frequently artistically carved) is of meerschaum, the stem being of wood, the best sorts of which are got from the young stems of the Mahaleb cherry, grown near Vienna, the mock orange of Hungary and the jessamine sticks of Turkey. The stem, whether of the same material as the bowl or of wood, is usually provided with a mouth-piece of ivory, silver or amber, the last being preferred. Briar-root pipes, with the bowl and stem of one piece of wood, and provided with amber, ivory or bone mouth-pieces. are now very common; they have little or no advantage over the clay pipe except in being less liable to break. Many Germans prefer pipes with porcelain bowls, which are sometimes beautifully painted in the style of fine chinaware painting. The Eastern hookah, or Turkish pipe, is a pipe of great length, the bowl of which is set upon an air-tight vessel partially filled with water, and has a small tube which passes down into the water; the long flexible smoking-tube is inserted in the side of the vessel. By exhausting the air in the smoking-tube, the smoke is forced down through the water, and entering into the space above it passes into the stem, cooled and freed from some of the most acrid properties of the tobacco.

In the United States, Indian pipes have been in use from very remote periods. They are found in the ancient mounds of the West, together with other relics of an unknown race. elaborately carved in stone into fanciful shapes, often resembling various animals of the country. In northern New York they are frequently discovered in plowing the land. Some are of soapstone and others of baked clay. In the account of the discovery of the Hudson River by Robert Juet, mention is made of «red copper tobacco pipes and other things of copper, which the savages did wear about their necks.» In the Northwest Territory, upon the summit of the dividing range between the Saint Peter's and the Missouri rivers, and in the latitude of Saint Anthony's Falls, the Indians have long procured a peculiar variety of red steatite or soapstone, of which all the red stone pipes of that region are made. The locality is held in great reverence by the Indians, and they have strongly opposed any attempts of the whites to visit it. Catlin, however, succeeded in overcoming their scruples, and was shown the spot at the base of a long vertical wall of quartz, which lay in horizontal strata, the pipestone layers spreading under the adjoining prairie land of the ridge, whence it was obtained by digging a few feet in depth. He judged from the great extent of the excavations, and from the graves and ancient fortifications, that the place must have been frequented by different tribes of Indians for many centuries. The pipes made of this stone are heavy and usually of rather plain form, decorated by bands and ornaments of lead, which appear to have been run into depressions made to receive it and then smoothed down. The stems are long and curiously carved sticks of hardwood, sometimes flat, frequently ornamented with gaily colored feathers of birds and horse hair dyed of scarlet hue.

The manufacture of the more expensive pipes in the United States began about 1860. Previous to that time they were imported; but the ordinary clay pipe has been in use since 1820. The earliest manufacturer whose name is now recorded was Thomas Smith, tobacco-pipe maker, of the city of New York, in 1847. The high tariff during the Civil War stimulated manufacturing. This was commenced on the smallest possible scale by two or three enterprising German workmen, with neither machinery nor experience. The goods could not be compared with the European product, and they were almost as expensive, even with the high tariff paid on the imported articles. Trade itself previous to the Civil War was very small. Edward Hen, who before 1860 was almost the only importer of note, was known as the pipe man of the United States. His pipe business was less than $50,000 per year. William Demuth, a pupil of Edward Hen, began the making of pipes in 1861. The local manufacture has steadily developed and by 1904 the pipe industry in the United States was not only equal to that at the celebrated factories in Vienna, Ruhla and Saint Claude, but surpassed the latter in many respects. Many improvements and inventions have been made in America, which were later introduced into Europe. There are now (1918) about 65 factories in the United States making tobacco pipes; they employ over 3,000 work people; have $4,000,000 invested capital and manufacture a gross product of $6,000,000 annually, nearly half of which they expend for materials. New York is the leading State in the industry, having 30 factories and turning out more than half the entire product.

PIPE-CLAY. See Clay.

PIPE-FISHES, small teleostomous fishes included in the order *Lophobranchii* (and with the sea-horses (q.v.) constituting the family *Syngnathidæ*). The gills are disposed in tufts on the branchial arches, the gill-cover is a simple plate and the gill-aperture of small size. The body is covered by bony plates arranged transversely, and in the pipe-fishes is very long and attenuated. No ventral fins exist, and the jaws are united to form a pipe or tube, bearing the small, toothless mouth at the tip.

A very curious and remarkable circumstance in connection with the pipe-fishes consists in the males of some species possessing a pouch-like fold, situated on the under side of the abdomen or tail, in which the eggs are contained after being extruded from the body of the females. And after the young fry are hatched they continue to reside within this pouch for a longer or shorter period, when the pouch opens and permits them to escape. No analogous structure is found in the female.

The family *Syngnathidæ* comprises about 15 genera and 150 species, all small fishes of warm seas, and most of them true pipe-fishes, which differ from the sea-horses in the possession of a caudal fin, while in the latter the fin is absent and the tail prehensile. Several genera of pipe-fishes occur in American waters, the principal one being *Siphostoma*, with at least 25 North American and West Indian species. The common pipe-fish (*S. fuscum*) is the only species found on the coast of the New England and Middle States and is very common in shallow bays and estuaries, where it lives among the vegetation. In this and related species the egg-pouch is formed of a pair of longitudinal folds which extend along the greater part of the long tail. All of the pipe-fishes are feeble swimmers, the fins being very small and weak; and their manner of moving through the thick vegetation may be described as crawling rather than swimming. They make very interesting tenants of salt-water aquaria. In *Daryrhamphus* the egg-pouch is beneath the abdomen; while the males of the genus *Syngnathus* carry the eggs uncovered on the skin.

The name pipe-fish is also applied to the members of the genus *Fistularia*, or trumpet-fishes, included in the order *Hemibranchii*. The bones of the face are prolonged to form a tubular structure, at the extremity of which the mouth opens. The *Fistularia tabaccaria* of the Antilles, averaging about three feet in length, represents this genus and occurs not infrequently on our Atlantic Coast.

PIPE LINES. A form of transportation that may be used for any liquid or gas, but which is principally employed to transport the petroleum and natural gas products from the wells in the oil fields to the refineries and the markets or points of utilization, with the minimum of expense. Soon after the discovery of petroleum in the United States the transportation of the product formed an important factor in the problems relating to its profitable marketing. Although petroleum was discovered as early as 1829, up to 1870 the use of wooden and iron tank cars prevailed, entailing a great cost in transportation and resulting in a comparatively slow disposal of the product. To lessen the cost of transportation, the practicability of employing a conduit of wrought-iron piping was suggested by Gen. S. D. Karns of Parkersburg, W. Va., as early as 1860, but pipe lines were not successfully operated until 10 years later. Karns' idea involved the principle of gravity; he proposed to lay a line of pipe from the wells at Burning Springs to Parkersburg, a distance of about 36 miles, and allow the oil to flow down to the shipping points on the Ohio River. Through a lack of enterprise more than any other reason, the line was never laid. His idea was taken up and developed by J. L. Hutchinson of New York, who in 1862 laid a pipe line from the Tarr Farm wells to the refinery at Plumer, Pa. As the wells and the refinery were situated on the opposite sides of the hill, the pipe line formed a siphon, which, under the effect of the high air pressure, leaked freely at the joints, and resulted in its final abandonment. He laid another line in 1863, from the well at Sherman to a refinery three miles distant. In this case the oil was pumped from the well to the refinery, but as in the former case the leakage at the joints was too great to allow the line to be a practical success. Between 1865 and 1870 a great many attempts were made to employ this method of transportation in the various oil fields throughout the country, with more or less success, in spite of the opposition of those interested in the employment of wagons and tank-cars, but the unqualified success of the line laid by Samuel Von Syckle of Titusville, Pa., from Pithole City to Miller's Farm, in 1865, induced the creation of numerous pipe-line companies, and the extension of the lines to distant shipping points. In 1875 the Pennsylvania Transportation Company, authorized to lay a pipe line from the oil regions to tide water, laid one from the lower oil regions to Pittsburgh, a distance of about 60 miles. Its operation was highly successful. The refineries, heretofore located near the wells, were removed to various ports on the seaboard, and on the shores of the Great Lakes, and the connecting pipe lines were rapidly laid. By 1877 10 or 12 pipe lines were being operated through the oil regions, while the laying of long-distance lines was commenced by the United Pipe Lines Company. By 1892 the National Transit Company controlled several great trunk lines. The great competition reduced the profits derived from pipe-line transportation and led to the consolidation of the companies, and by 1902 two companies, of which the National Transit Company was the larger, controlled all of the pipe lines in the United States. It is estimated that the National Transit Company, handling the output of the Standard Oil Company, exclusively, controlled in 1904 about 40,000 miles of pipe line and in 1918 over 50,000 miles. Of foreign countries, Russia has built the most pipe lines. The first line was laid in 1879. from the Baku wells to a refinery situated at a distance of about nine miles. By 1895 over 20 pipe lines were in operation, and long-distance lines were later constructed. The line from Mikhoilov to Batum, laid in 1900–01, was originally 145 miles in length, but now connects with Baku, a total of about 550 miles. Several hundred miles of pipe lines have been laid in Mexico, and doubtless will be extended as political disturbances subside. See PETROLEUM.

Oil pipe lines connect points by straight lines as near as possible, and are usually laid below frost line, two or three feet under the surface of the ground, the undulations of which they follow throughout their entire course. They are constructed of wrought-iron pipes four to eighth inches in diameter and are provided with bends at regular intervals to take up the expansion and contraction due to varying temperatures. Pumping stations and storage tanks are placed at intervals of 30 miles, or they are located at central points in the valleys along the lines, to pump the oil over the intervening hills and mountains. High pressure compound condensing pumps are used, working under a head depending upon the topography of the country through which the line is laid and upon the friction due to the diameter of the pipe and the length of the line. The plugging up of the pipes by sedimentary deposits is prevented by occasionally running a «go devil» scraper through the pipes, which is forced along from station to station with the oil by the pressure of the pumps, and scrapes off the paraffin incrustations.

Pipe lines for conducting natural gas vary in construction greatly, being made from wrought-iron piping two or three inches in diameter, large cast-iron pipes, or from riveted steel-plate tubes, ranging from 15 to 25 inches in diameter. In the United States the use of natural gas followed the general development of the petroleum industry. Numerous gas-pipe lines were established in the various gas producing areas, some of which are in operation at the present time, while many have been abandoned upon the exhaustion of the wells. Each of the main lines is about 50 miles in length and originally conducted gas at pressures ranging from 200 to 1,200 pounds per square inch. In late years, however, these pressures have decreased enormously, being now but a small fraction of what they were, and necessitating the employment of pumps to maintain a delivery pressure ranging from 10 to 50 pounds per square inch. See GAS, NATURAL; STANDARD OIL COMPANY.

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PIPER, The. Josephine Preston Peabody's 'The Piper' won a prize offered in competition by the English actor, F. R. Benson, for the best poetic drama. It had previously been submitted to the New Theatre, New York, but had been rejected. The interest created by its production at the Memorial Theatre, Stratford-upon-Avon, by the Benson Company, on 26 July 1910, warranted a reconsideration of the play by Mr. Winthrop Ames, with the result that it was given a colorful première at the New Theatre, on 30 Jan. 1911, Miss Edith Wynne Matthison in the rôle of The Piper. It was hailed by the American critics as the precursor of a poetic revival on the stage. But thus far (1919) the American theatre has been pledged to the drama of condition, of psychology, rather than of poetry. And Miss Peabody's 'The Piper' stands better known as a reading drama than as a piece of the theatre. Judged as poetry, its story is clothed in a symbolism which makes the old legend of The Pied Piper of Hamelin take on a significant modern application. Judged as drama, its pictorial effectiveness is hampered by the infusion of social and Christian ethics, which are not as fully developed as they should have been. To Miss Peabody, The Piper represents the singing, free side of life, whereas Hamelin and its stodgy population are measure of the selfish, money-grubbing side of daily existence. The old Piper of Browning's poem and of the German folktale was simply a rat exterminator of prodigious merit. Miss Peabody's Piper is the enchanter of childhood, and by his playing he would free them of Hamelin, which is inimical to the child spirit. His is not the compassionate love of Christ for little children, but it has the same lyric charm. The Lonely Man of the Cross who fascinates the crippled Jan, and his mother — the only Mother of Hamelin who goes forth in the right spirit to seek her child whom the Piper has lured away — are the spiritual threads on which the philosophy of the play is strung. This philosophy, slim though it be, has poetic beauty and universal applicableness. In a sensual way Ibsen's the Rat Wife in 'Little Eyolf' is recalled by the Piper legend. And the ethics of the play seem to be this: that in all the Hamelins of this world, there are parents whose worldly vision separates them from a joyful life lived with their children. To preserve this life, the Piper, at the close of the play, goes onward, piping his lure of childhood until Christ's love for little children enters all our hearts.

Miss Peabody (Mrs. Lionel Marks) studied dramaturgy under Prof. G. P. Baker, at Harvard, and was for a time instructor of English at Wellesley College. In addition to 'The Piper,' she has written the following dramas: 'Marlowe' (1901); 'The Wings' (1905); 'The Wolf of Gubbio' (1913).

MONTROSE J. MOSES.

PIPERAZINE, Diethylene diamine $NH\left\langle\begin{matrix}CH_2.CH_2\\CH_2.CH_2\end{matrix}\right\rangle NH$, is obtained, mixed with a number of basic substances, by the interaction of ammonia and ethylene bromide or ethylene chloride. The crude product is purified by treatment with nitrous acid, which forms a nitroso derivative; the latter will readily yield piperazine by the action of a reducing agent.

The manufacture of piperazine on a commercial scale involves the following steps: (1) The formation of diethylene diphenyl diamine by treating ethylene bromide with aniline and anhydrous sodium carbonate; (2) the conversion of this compound into a nitroso derivative by the action of sodium nitrate in the presence of hydrochloric acid; (3) the liberation of piperazine from the nitroso derivative by first treating it with sodium bisulphite and then with sodium hydroxide.

Piperazine is a crystalline hygroscopic compound having a melting point of 104°–107° C. and a boiling point of 140°–145° C. It readily dissolves in water, absorbs carbon dioxide from the air with great avidity and shows strongly basic properties forming crystalline salts with inorganic and organic acids. Of special interest is the salt which it forms with uric acid converting it into a soluble compound. This property of piperazine has made it a popular remedy for diseases caused by the accumulation of uric acid in the body. Piperazine has therefore been recommended as an efficient cure for gout, rheumatism, uric acid gravel and calculi. Piperazine is especially valuable as a remedy for these diseases since it passes through the system without any toxic action. A number of piperazine derivatives have also been recommended as solvents for uric acid; of these, piperazine quinate or Sidonal, dimethyl piperazine tartrate or Lysetol, and dihydroxy piperazine are well-known examples.

V. S. Babasinian.

PIPERINE, PIPERIDINE, PIPERIC ACID and PIPERONAL. PIPERINE ($C_{17}H_{19}NO_3$), an alkaloid found in different varieties of pepper and related to both pyridine and pyrocatechnic acid. Obtained from black pepper by extraction with hot alcohol. A colorless crystalline substance, insoluble in water, soluble in alcohol, ether and other like solvents. When digested with a hot alcoholic solution of caustic potash it breaks down into piperidine and piperic acid. Piperidine ($C_5H_{11}N$) or hexahydropyridine is an oily liquid boiling at 106° C., soluble in both water and alcohol, having the odor and taste of pepper. Piperic acid ($C_{12}H_{10}O_4$) is a monobasic, pale yellow crystalline acid, slightly soluble in water, somewhat more so in alcohol. Careful oxidation in dilute neutral solution with permanganate of potash gives piperonal (heliotropine ($C_6H_3O_2.CHO$), a colorless crystalline body, soluble in both water and alcohol and having a very pleasant aromatic odor. Used in perfumery. It is closely related to vanillin, the flavoring principle of vanilla bean. All of the above compounds have been made in the laboratory by various synthetic processes.

PIPESTONE, Minn., city and county-seat of Pipestone County, on the Chicago, Milwaukee and Saint Paul, the Chicago and Northwestern, the Great Northern and the Rock Island railroads, about 200 miles southwest of Minneapolis. Pipestone is important as a grain-shipping centre and the distribution centre of a large and populous district. The noted Indian pipestone is quarried nearby. The city contains an Indian training school, a public library and a creamery and several wholesale depots. The city was settled in 1878 and received its charter as a city in 1901. Pop. 2,475.

PIPEWORT, an acaulescent, or very short-stemmed bog or aquatic plant, with tufted grass-like basal leaves and very small flowers in terminal solitary heads on long, slender, hollow, ribbed scapes. Many species exist in the family *Eriocaulaceæ*.

PIPING CROW, a bird (*Gymnorhina tibicen*) of New South Wales, remarkable for its musical powers and for its ability in mimicking the voices of other birds and uttering a few parrot-like words. It is black and white in color and is allied to the shrikes.

PIPIRI, pē-pē'rē, a West Indian name for the large tyrant flycatchers known in the United States as kingbirds, especially *Tyrannus dominicensis*.

PIPISTRELLE, one of the smallest and most familiar of European bats (*Vespertilo ripistrella*).

PIPIT. See Titlark.

PIPPA PASSES. This brief but delightful poetic drama by Browning was published as the initial number of 'Bells and Pomegranates' in 1841, and, according to Mr. Gosse, was the first work of its author to win the public. Mrs. Orr says that it was conceived when the poet was once walking in a wood near Dulwich. There came to his mind the image of some one, unimportant in himself and unconscious of his influence upon others, walking alone through life and yet influencing permanently the lives of those whom he met. The image took shape in the person of one of Browning's most charming imaginative creations, Felippa, or «Pippa,» the little Italian girl of Asolo, near Venice, who on her one holiday of the year passes singing through the streets and by her songs changes the lives of the other persons of the play. The time of 'Pippa Passes' is the early 19th century, the «local color» that of Asolo, but the story has no historic foundation. The play consists of prologue and epilogue spoken by Pippa in her room; of four principal scenes, which take place respectively in the morning, noon, evening, and night of Pippa's holiday; and by three interludes on the streets. The form is free lyric verse in Pippa's monologues and songs, blank-verse in the first, second and third scenes, and prose in the fourth scene and the interludes. Pippa, wishing to make the most of her holiday, alone, yet longing to love and be loved, identifies herself with those whom she fancies must be the happiest in Asolo— with Ottima and Sebald, the guilty lovers in the great house on the hill; with Luigi and his loving mother; with Jules the sculptor and Phene his bride; and with Monsignor the Bishop, who loves but God. As Pippa passes in turn by the houses of these persons, her song greets each at a crisis of his life. Ottima and Sebald are spiritually saved; Jules, about to send away the ignorant and baseborn Phene, whom he has been tricked into marrying, lifts her instead up to his own level and into his heart; Luigi, about to yield to his mother's plea that he give up his dangerous patriotic mission, chooses death rather than safety; and Monsignor the Bishop, tempted to sin through avarice, turns upon his tempter and saves his soul.

Pippa's songs are not impressive in themselves; their power and significance lie only in the hearer's state of mind, but they change the course of destiny; for «all service ranks the same with God,» with whom «there is no last nor first.» Each of the four scenes, complete in itself, is essentially and intensely dramatic; the characters are all individualized, though their speech is rather the speech of Browning; the style is always appropriate and at times, with its intensity of feeling and magnificence of imagery, rises to the heights of very great poetry. The scenes are given background and continuity by the interludes in the streets, in which figures artists, village girls, and the Austrian police. Pippa has no personal concern in the action save in the last scene, in which by her singing she unconsciously saves herself from death or worse. The human truth underlying the conception of the play, the dramatic force of the various scenes, the representative characterization and the always forceful and often superb style, combine to render ‘Pippa Passes’ one of the very few remarkable poetic dramas in recent English literature, almost the only one, in fact, that has gained a large reading public and yet has qualities that fit it for the stage. Although not written for the theatre, it has repeatedly been presented in special performances with all the fine effect to be expected from its essential dramatic quality. Rolfe's ‘Select Poems’ contains ‘Pippa Passes’ with introduction and notes, and Miss Burt discusses the character of Pippa in her ‘Browning's Women’.

Marion Tucker.

PIPPAL, an Indian tree. See Peepul.

PIPPI, pĭp pē, **Giulio.** See Giulio Romano.

PIPPIN, the name given to a certain class of desert apples, probably because the trees were raised from the pips or seeds, and bore the apples which gave them celebrity without grafting. They seem to have been introduced into Great Britain from France, and were little known there until about the end of the 16th century. In the time of Shakespeare pippins were delicacies for the dessert: Sir Hugh Evans, in the ‘Merry Wives of Windsor,’ says: «I will make an end of my dinner — there 's pippins and cheese to come.» Justice Shallow, in his invitation to Falstaff, says: «You shall see mine orchard, where, in an arbour, we will eat a last year's pippin of my own grafting.» The ribston, golden, Newton, and the small Scoth oslin or arbroath pippin are favorite sorts. See Apple.

PIPSISSEWA, a plant, prince's pine (q.v.).

PIQUA, pik'wą or -wä, Ohio, city in Miami County, on the Miami River, the Miami and Erie Canal, and on the Pittsburgh, Cincinnati, Chicago and Saint Louis and the Cincinnati, Hamilton and Dayton railroads, about 70 miles northwest of Columbus. The extensive water-power has contributed toward making the city an important industrial centre. The chief manufacturing establishments are large oil-mill machinery works, strawboard mills, woolen mills, furniture factory, rolling mills, ironworks, stove and range works, and sheet steel-mills. Its educational institutions are a high school, public and parish schools, and the Schmidlapp Free Library. The city owns and operates the waterworks. Pop. 14,880.

PIQUÉ (pē-kā') **WORK,** an old form of decoration consisting of a pattern made up of small lozenge-shaped units: made in fabrics with a needle or in hard surfaces by inlaying.

PIQUET, pē-kā', a game of cards played between two persons with 32 cards, all the plain cards below seven being thrown aside. On the cards being shuffled the players cut for deal; the party drawing the lowest card has to deal first. The cards are then dealt two by two until each player has 12 cards, the eight remaining undealt (called the stock) are laid on the table between the players. The first hand (the non-dealer) must then discard five or less of his cards (he must discard at least one), exchanging them for an equal number drawn from the stock; the younger hand (the dealer) may exchange from the stock three or less, but may refuse to exchange altogether. In playing, the cards rank in order as follows: the ace (which counts 11), the king, queen and knave (each of which counts 10) and the playing cards each of which counts according to the number of its pips. The player who first reaches 100 has the game. The score is made up by reckoning in the following manner: Carte blanche, the point, the sequence, the quatorze, the cards and the capot. Carte blanche is a hand of 12 plain cards, and counts 10 for the player who holds it. The point is the suit of highest value, the value being determined by the number it makes up when the cards held are added together; thus, if a player holds ace, king, ten, nine and eight, his point would be 48. The first player having called a point, the younger hand must then say whether his point is superior, equal or inferior in value to his opponent's, by calling in the first place «good,» in the second «equal,» and in the last «not good.» If the elder hand's point is «good» he at once shows it, and counts one for each card in it, except with the points 34, 44, 54 and 64, which count one less than the number of cards. If the points are equal he counts nothing. The sequence is composed of a regular succession of cards in one suit, and the highest sequence. The quatorze is composed of four aces, four kings, four queens, four knaves or four tens, and counts 14. The winner of the greatest number of tricks counts 10 in addition (the «cards»), if he holds all the tricks he counts 40 in addition (the «capot»). For the sake of convenience the scores are generally recorded at the end of the hand; but they are recordable no matter by which hand they are made, according to the following table of precedence: 1, carte blanche; 2, point; 3, sequences; 4, quatorzes and trios; 5, points made in play; and 6, the cards. If one player scores 100 before the other obtains 50 he wins a double. Consult Cady, ‘Piquet’ (1896).

PIRACICABA, pē-rä-sē-kä'bä, Brazil, a town of the state of São Paulo, on the Pirarcicaba headstream of the Tieté affluent of the Parana River, about 100 miles northwest of São Paulo with which and Rio de Janeiro, 270 miles eastward, it is connected by rail. It has an active export trade in the coffee and sugar of the surrounding region. Pop. 25,374.

PIRACY. See Pirate.

PIRACY IN STREAMS. See Stream Piracy.

PIRÆUS, pī-rē'ŭs, Greece, the port of the city of Athens, lying five miles southeast of the city and now terminus of railroads to Athens and to the Morea. Three excellent harbors indent the shore deeply, Piræus, Zea and Munychia. Munychia is also the name of the mountainous peninsula separating the harbor from the Saronic Gulf, and on this peninsula is the town, which was built 493 B.C. by Themistocles, whose able policy of Athenian defense soon effected the construction of the famous «long walls.» These made Athens independent of the rest of Attica, as was plainly seen in the Peloponnesian War, when, with the additional walls built by Cimon and Pericles, Athens was undisturbed, although all Attica outside of the walls was in the hands of the Peloponnesians. But the destruction of the remains of the Athenian navy at Ægospotami in 404 B.C. left the port defenseless; it was taken and the walls were destroyed to the music of the flute. Conon rebuilt them 10 years later, and Athens temporarily regained some of its importance. But the splendid city, one of the master works of the Periclean age, was finally destroyed by Sulla in 86 B.C., and there was only a wretched village on its site even some years after 1836, when Athens again became the capital of Greece. But in 1835 the old name had been revived, to take the place of Porto Leone, the name given by the Italians. The present city is modern in its construction; has street railways, a gymnasium, exchanges and theatres; is the second port in Greece, being outranked only by Syra; manufactures macaroni, cheese, cognac, liquors and various textiles; has a large import and a moderate export trade; and is the main station of the Austrian Lloyds Company and of various steamship lines, so that it is in direct connection with Trieste, Corfu, Constantinople, Smyrna, Alexandria and Marseilles. In 1915, 3,827 steamships of 2,430,680 tons entered at this port, two-thirds of this tonnage flying the Greek flag. There are several consulates. The population of the city is estimated as about 75,000. Consult Weller, C. H., ‹Athens and Its Monuments› (New York 1913).

PIRAI, pi-rī, or **PIRAYA,** pī-rä'yä (*Serrasalmo piraya*), voracious fresh-water fish of the caribe family of tropical America. It is three or four feet in length and its jaws are armed with sharp lancet-shaped teeth, by which cattle when fording rivers sometimes suffer terribly. So sharp-edged are the teeth that they are mounted and used as knives by the Indians of Guiana, for pointing their blow-pipe arrows, etc. See CARIBE.

PIRANESI, Giovanni Battista, jō-vän'nē bät-tēs'tä pē-rä-nā'zē, Italian architect and engraver: b. Venice, 4 Oct. 1720; d. Rome, 9 Nov. 1778. He passed the greater part of his life at Rome. He published ‹Antichita Romane› (1756); ‹Antichita d'Albano e di Castel Gandolfo›; ‹Trofei d'Ottaviano Augusto›; ‹Della Magnificenza ed Architettura de' Romani,› and over 100 views of modern Rome. His architectural designs display much grandeur and fertility; but his representations of real objects are not always faithful. His son and pupil, Francesco, continued the publication of works on similar lines.

PIRATE, one who sails the seas for the purpose of robbery, whether in command of a ship or as one of the crew; a highwayman of the sea; a freebooter, or buccaneer. Piracy is the term applied to the crime of robbery committed upon the high seas. It is an offense against the universal law of society. As the pirate has renounced all the benefits of society and government and has reduced himself to the savage state of nature, by declaring war against all mankind, all mankind must declare war against him; so that every community has a right, by the rule of self-defense, to inflict that punishment upon him which every individual would, in a state of nature, otherwise have been entitled to do for any invasion of his person or personal property. By various statutes in England and the United States other offenses are made piracy. Thus, if a subject of either of these nations commits any act of hostility against a fellow-subject on the high seas, under color of a commission from any foreign power, this is an act of piracy. So, if any captain of any vessel, or mariner, run away with the vessel, or the cargo, or yield them up to a pirate voluntarily, or of any seaman lay violent hands on his commander, to hinder him from fighting in defense of the ship or goods committed to his charge or make a revolt in the ship, these offenses are acts of piracy by the laws of England. By statute of George II the ransoming of any neutral vessel, which has been taken as a prize, by the commander of a private ship of war, is declared to be piracy. By the act of Parliament, passed in 1824, the slave-trade is also declared to be piracy. In the time of Richard I, all infidels were regarded as pirates and their property was liable to seizure wherever found. By the law of nations the taking of goods by piracy does not divest the actual owner of the property. Piracy, with intent to murder, stab or wound, is capital and pirates can gain no rights by conquest. It is of no importance, for the purpose of giving jurisdiction in cases of piracy, on whom or where a piratical offense is committed. A pirate, who is one by the law of nations, may be tried and punished in any country where he may be found; for he is reputed to be out of the protection of all laws. But if the statute of any government declares an offense, committed on board one of its own vessels, to be piracy, such an offense will be punished exclusively by the nation which passes the statute. In England the offense was formerly cognizable only by the admiralty courts, which proceeded without a jury, in a method founded upon the civil law. In the United States piracy is tried in the Federal courts.

Piracy, in the common sense of the word, is distinguished from privateering by the circumstance that the pirate sails without any commission and under no national flag and attacks the subjects of all nations alike; the privateer acts under a commission from a belligerent power, which authorizes him to attack, plunder and destroy the vessels which he may encounter belonging to the hostile state. He is not regarded as a pirate by the laws of nations, but in accordance with these is bound to observe certain rules and restrictions. Thus, he is debarred from attacking the vessels of the enemy while lying in any port or haven under the protection of a friendly or neutral state. It was held by many experts in international law that the U-boats of Germany, though commissioned by their governments, were engaged in piracy whenever they attacked neutral vessels. See NEUTRALITY.

PIRATE BUG, a predaceous bug of the family *Reduviidæ*. See CONE-NOSE.

PIRATES OF PENZANCE, The, a comic opera by William S. Gilbert and Sir Arthur Sullivan, which was produced 31 Dec. 1879 in New York City and in London on 3 April 1880.

PIRENE, pī-rē'nē, a spring of crystal water at Corinth, which in Greek tradition was sacred to the Muses.

PIRITHOUS, pī-rĭth'ō-ŭs (Gr. *Peirithoos*), in Grecian mythology, a son of Zeus and Dia, the wife of Ixion; he was king of the Lapithæ. At the marriage of Pirithous with Dejanira, Eurythion, one of the Centaurs, attempted to do violence to the bride and thence resulted the famous battle of the Centaurs and Lapithæ. After the death of Dejanira (also named Hippodamia) Pirithous with his trusty friend Theseus carried off Helen from Sparta. At Athens it was decided by lot which was to have her and Theseus won; but under the conditions of the lot the winner must help his comrade to procure a wife and Pirithous' choice of a wife was Proserpine, wife of Pluto. To the infernal kingdom, therefore, the two heroes went down, but suddenly were powerless to stir from the seats they had taken. Afterward Hercules delivered Theseus, but Pirithous remained in Hades for evermore, loaded with 300 chains.

PIROGUE, pĭ-rōg', or **PERIAGUA,** pĕr-ĭ-ä'gwą, the name given a small canoe used on the Western rivers of the United States and in Central and South America. It is commonly cut from a single log and is popularly known as a dug-out. In the West Indies a larger boat deckless, but with two masts, bears the name.

PIRON, pē-rôṅ, **Alexis,** French wit, poet, and dramatist: b. Dijon, 9 July 1689; d. Paris, 21 Jan. 1773. He studied law as Besançon and later went to Paris, where he produced in 1738 his *chef d'œuvre,* 'Metromanie,' a comedy which Laharpe characterizes as excelling in plot, style, humor and vivacity almost every other composition of the kind. In the latter part of his life he made repeated attempts to gain admission into the French Academy, but without success. He revenged himself for his disappointment by calling the Academy *Les invalides du bel esprit,* and composing the humorous epitaph:

> "Ci-gît Piron, qui ne fut rien,
> Pas même académicien."
>
> "Here lies Piron, who was nothing —
> Not even an Academician."

There is a collective edition of his works by Juvigny (1776). Troubat published 'Œuvres Choisies de Piron' in 1890.

PISA, pē'zä or -sä, Italy, a province of Tuscany and its capital city. (1) The province of Pisa, bounded on the north by Lucca, on the east by Florence and Siena, on the south by Grosseto, and on the west by Livorno and the Ligurian Sea, has hills in the south and east, notably the Monti Pisani and the Monti di Volterra, and at the west a fertile plain, watered by the Arno and Serchio, and rich in vines and olive orchards. Its mineral wealth is marble, alabaster and mineral waters; and its industries cotton and silk spinning. Its area is 1,185 square miles and its population in 1915 was 351,841, of which 270,080 are in the district of Pisa, the others living in the second district of the province, Volterra. (2) The capital of the province, situated on both banks of the Arno, about seven miles from its mouth, is on the railroads between Genoa and Rome and between Florence and Livorno, and is the terminus of a line running from Pistoja through Lucca. The streets are old and crooked, but well paved and broad, and lined with substantial dwellings, many built of marble. The modern city is on the south side of the Arno and contains one old building of importance, the Gothic church of Santa Maria della Spina, on the Lungarno, that is, the street "along the Arno," which is peculiarly picturesque on either side of the river. In the old city to the north are the cathedral, built of dazzling white marble in 1063 to commemorate a naval victory near Palermo, with a façade formed of four galleries of pillars, bronze doors designed by John of Bologna, and within five naves separated by Greek and Roman columns, the spoil of various Pisan victories, and 12 lateral altars attributed to Michelangelo, but probably the work of Stagi di Pietra Santa; the Baptistery, begun in 1153 and finished in 1278, a great dome-crowned rotunda 190 feet high, in which are a fountain executed by Guido Bigarelli in 1246, and a chair supported by seven columns and decorated in fine bas-relief by Nicolas Pisano (1260); the Campanile or Bell Tower, better known as the leaning tower of Pisa, finished in 1350 by Tommaso Pisano, with its six galleries of pillars, a total height of 179 feet and a deviation from the perpendicular of 14 feet; and the Campo Santo, originally a cemetery filled in with earth from the Holy Land at the close of the 12th century, and between 1278 and 1283 surrounded by Giovanni Pisano with a rectangular portico more than 400 feet long and 170 feet wide, decorated on the outside with frescoes by Florentine and Siennese artists of the 14th and 15th century, notably the 23 scenes from the Old Testament by Benozzo Gozzoli and the 'Triumph of Death' and 'Last Judgment' by the two Lorenzetti; on the inside are funereal monuments of different periods. There are many other buildings of beauty in the city, mostly churches; mention should be made of the Palazzo Medici on the Lungarno, built in 1027 and enlarged three centuries later, of the University with an early Renaissance court, and of the Palazzo Lanfreducci, built (1590) of Carrara marble.

The industry and commerce of the city are slight, but it has cotton factories, machine shops, glass and hat factories, and also produces alabaster. The city is a favorite winter resort because of its mild and delightful climate. It has rail connections as noted above and steamboat lines to Marina and Pontedera. It is the seat of an archbishop, of a civil and a military governor, and of a court of the first resort. Its educational equipment includes the University, founded in 1338, closed in 1359, revived in 1364 only to die out again in 1406, and newly established in 1473 by Lorenzo, and in 1542 by Cosimo de Medici, and again in 1838 by Leopold II of Tuscany, and at present made up of faculties of law, philosophy, medicine and surgery and mathematics and natural science, with 1,200 students in 1915; related to the University are normal, engineering, pharmaceutical, veterinarian and agricultural schools, a museum of natural history, founded in 1596, and particularly rich in Tuscan ornithology and geology, and a botanical garden, as well as a library of over 200,000 volumes, excluding pamphlets; and there are also secondary schools, technical and industrial schools, a valuable library in the archiepiscopal seminary, a Museo Civico, and archives with documents dating back to the city's relations with Frederick Barbarossa and Richard I of England.

Pisa was one of the 12 cities of the Etruscan confederation, became a Roman colony 180 B.C., and in the 9th and 10th centuries took a prominent place in Italy. In the 11th century its power was extended to Sardinia and Corsica (1050), it defeated the Saracens (1063) off Palermo, and took part in the first crusade. About 1100 its population was estimated at 150,000. The city sided with the Ghibellines and suffered severely when the Guelfs were victorious. The long feud with Genoa, came to an end with the Pisan defeat in 1283 at Leghorn, and in 1300 Sardinia, Corsica and the Belearic Islands were evacuated. Twenty-five years later Aragon got control of Pisa, which changed owners several times in the next three quarters of a century, and in 1406 was sold to Florence. In 1409 the Council of Pisa (q.v.) met (25 March). Pisa rebelled against Florence in 1494, fought bravely for 15 years, and were finally reduced by starvation. As an appanage of Florence it became a part of the grand-duchy of Tuscany, and thus entered the Italian kingdom in 1860. Consult Rohault de Fleury, ‹Les Monuments de Pise au Moyen Age› (1866, with atlas); Schubring, ‹Pisa› (1902); Valtancoli-Montazio, ‹Annali di Pisa› (1845); Langer, ‹Politische Geschichte Genuas und Pisas im 12 Jahrhundert› (1882). Pop. of commune 67,285.

PISA, Council of, an assembly of bishops and theologians generally but not universally accounted by Catholic divines to be œcumenical. It was called by leading cardinals belonging to the two «obediences» into which the Church was at the time divided, the «obedience» of Gregory XII, canonically elected in 1406, and that of Benedict XIII (Peter de Luna), anti-pope since 1395; and its purpose was to end the schism. The two rivals promised to withdraw their claims and to abdicate, so that then a pope might be elected with undisputed title. But the promises were not kept. The council met 25 March 1409, and was dissolved 7 August. The number of bishops who attended in person or by deputy was 200, of cardinals 20, of abbots near 300. When the rival popes refused to submit their claims to the council's judgment, the cause of each was weighed, and both of them were declared deposed, and the election of a new pope demanded of the college of cardinals. The cardinals elected Cardinal Philargi, who took the name of Alexander V. But as Benedict and Gregory persisted in their claims the situation was only made worse, and the schism, which already had for 30 years divided the Church, continued eight years longer, till it was ended by the action of the Council of Constance. Previously, in 1133, there was a council at Pisa, which condemned Peter de Bruys. Again in 1511 a council was called then to condemn Pope Julius II, but the cardinals refused.

PISACAS, pē-shä'käs, in Hindu mythology, certain base and cruel demons, who devour human flesh; they are practically ghouls, embodying the spirit of lying, adultery and lunacy. Agni, the pure spirit of fire, is implored to drive them away, and by certain incantations these malignant spirits can be induced to cure diseases and perform other beneficent offices. According to early tradition they were produced by creative power from the drops of water which were scattered, in superfluous profusion at the creation of beneficent beings — gods, men, etc., or as the children of Prajapati, or of one of the Prajapatis.

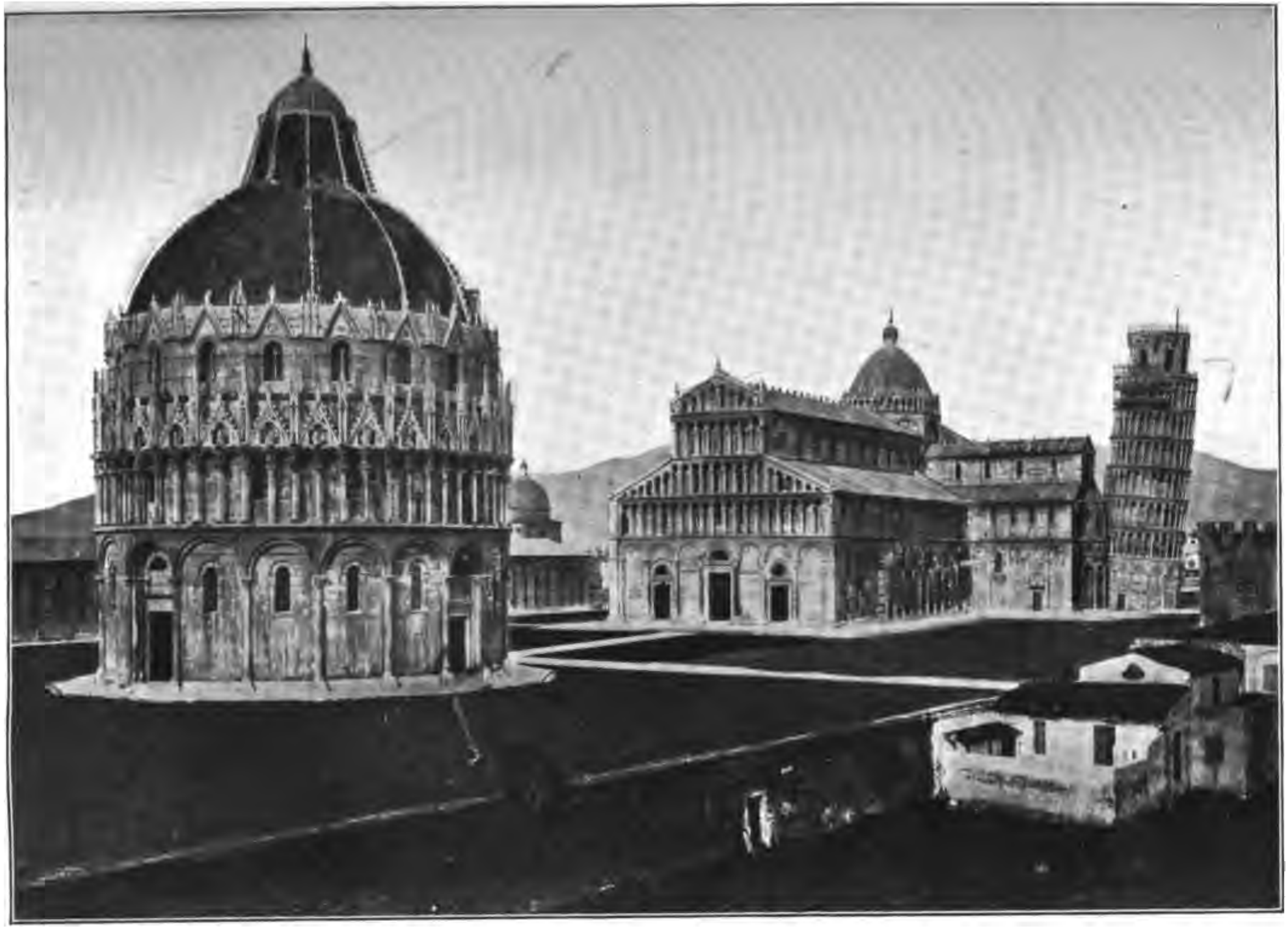
PISAGUA, pē-sä'gwä, Chile, a port of the province of Tarapaca, on the Pacific Coast, 40 miles by rail north of Iquique. On 18 April 1879 the city was bombarded and destroyed by the Chileans; and near the town, 19 Nov. 1879, occurred a battle in which the combined forces of Peru and Bolivia, numbering about 11,000, were defeated by a Chilean force of 6,000. Pisagua ships large quantities of nitre brought from the interior. It has a foreign commerce totaling about $8,000,000 annually. Pop. about 5,000.

PISANITE, a mineral consisting of sulphate of iron and copper $(Fe\ Cu)\ So_4.7H_2O$. Common in old drifts at Butte, Montana, and in Old Jordan mine, Bingham, Utah.

PISANO, pē-zä'nō, a surname or appellation of several artists of Pisa, distinguished in the early history of Italian art; among them are: (1) Giunta Pisano, or G. di Pisa, also styled Giunta di Giustino: the earliest known Pisan painter (about 1190–1250). He is supposed to have been a pupil of the Byzantine painters who came to Pisa after the capture of Constantinople by the Venetians, and to him belongs the credit of reviving the art of painting in Italy. (2) Niccola Pisano (about 1200–1275), eminent alike in sculpture and architecture, the greatest artist of the 13th century, and one of the restorers of the ancient classic sculpture, getting his inspiration from the sculpture of an ancient sarcophagus brought from Greece. Three works typical of his style are extant, namely, the pulpit in the baptistery of Pisa, the shrine of Saint Dominic at Bologna and the pulpit of the Siena Cathedral. (3) Giovanni Pisano (about 1235–1320), son of Niccola, an artist hardly inferior to his father as sculptor or architect. His most celebrated works are the Campo Santo of Pisa, the magnificent high altar and reredos in the cathedral of Arezzo, the splendid façade of the cathedral of Siena, and the church of Saint Dominic at Perguia, the north transept of which contains his beautiful tomb of Benedict XI. The little chapel of Santa Maria della Spina at Pisa was the most beautiful of his architectural works; but it has been spoiled by «restoration.»

PISANO, Vittore, commonly known as PISANELLO, Italian painter and medalist: b. San Virgilio, on Lake Garda, 1380; d. 1456. He exercised his art in Verona, Venice, Pavia, Rome, Ferrara, Rimini, Milan, Mantua, and Naples.

PISA



Baptistry, Cathedral and Leaning Tower

Several of his paintings are still to be seen in Verona and among them an ‘Annunciation’ in the church of San Fermo and a ‘Saint George’ in that of Santa Anastasia. These pictures are in fresco. His principal fame, however, comes from the fact that he was one of the first artists to model portraits and cast them in metal medals. His works are prized as among the most excellent historical memorials of his time.

PISANUS, pĭ-sä'nŭs, **Leonardus** (Leonardo di Pisa), Italian mathematician of the 13th century: b. Pisa, about 1160. His father, called Bonaccio (probably a nickname), was in the employ of the merchants of Pisa, who had establishments for trade on the southern and eastern coasts of the Mediterranean, and Leonardo, whose nickname in his boyhood was Bigollone (dunce), was destined by his father to be a clerk or accountant in one of the factories. To fit him for this station he was sent to the town of Bugia in Algeria, a noted emporium at that time, resorted to by the European and Arab merchants. Later, in his travels round the Mediterranean, he so improved his opportunities as to acquire an extraordinary fund of erudition. Returning to Italy in 1202 he published his ‘Liber Abaci,’ in which are set forth the most perfect methods of arithmetical calculation. It is a voluminous treatise, occupying 459 pages in the printed edition of the author's works; and deals arithmetically and algebraically with the most difficult and complex problems. He had mastered the geometry of Euclid and the algebra of Mohammed ibn Musa. Besides the ‘Liber Abaci,’ he wrote ‘Practica Geometriæ’; ‘Liber Quadratorum’; and some minor treatises.

PISAY, pē'zä. See Pisé.

PISCATAQUA, pĭs-kăt'ą-kwą, a river on the boundary between Maine and New Hampshire. It has its rise in East Pond, between the towns of Newfield, Maine and Wakefield, N. H. The upper part of its course is called Salmon Falls River. After passing Dover, N. H., it is connected with a tidal lake, and then flows past Portsmouth to the Atlantic. From Portsmouth to the sea — three miles — there is but little obstruction by ice — the strong tide preventing. The harbor is one of the best in the United States. The entire river is about 82 miles long.

PISCES, pĭs'ēz, that group of animals called fishes; the term has been variously limited with varying views of affinity and classification. See Fish; Ichthyology.

PISCES, *in astronomy,* a sign of the zodiac, which is entered by the sun about 19 February. The constellation which occupies the zodiacal region corresponding to the sign has the same name; it contains some interesting double stars.

PISCICULTURE. See Fish Culture.

PISCINA, pĭ-sī'ną, in Roman antiquities, a large water basin or pool, often one in which fish were kept. In ecclesiastical architecture, the stone basin used to receive the water after it has been used for washing the chalice, subsequent to the eucharistic celebration. The piscina is supplied with a drain-pipe to carry the water out of the church, and is usually constructed in the southern wall of the sanctuary. It sometimes takes the form of a canopied niche decorated with carving.

PISCO, pēs'kō, Peru, a city and port of the department of Ica, on the bay of Pisco, where the Chunchanga River empties into it. A railroad connects it with the inland cities of the department. It exports cotton, sugar, silver, wine, salt and spirits, and has a large distillery. Pop. about 4,000.

PISEMSKI, pē'sĕm-skē, **Alexei Feofilaktovitch**, Russian novelist: b. Ramene, Kostroma, Russia, 20 March 1820; d. Moscow, January 1881. He was educated in the University of Moscow and was for some years engaged in government service, resigning in order to devote himself wholly to literary pursuits. His work, which belongs to the realistic school, is of a most sombre and cynical type, betraying an entire lack of high ideals and a failure to recognize anything noble or good in humanity. His most successful novel, ‘A Thousand Souls,’ was published in 1858, and much of his work has been translated into German and French. Among his books are ‘Boyarshchina’ (1847); ‘A Bitter Lot’ (1853); ‘The Stormy Sea’ (1863); ‘In the Whirlpool’ (1871). His complete works were issued in 24 volumes in 1895.

PISGAH, pĭz'gą, a mountain in Palestine, in the Abarim Range, east of the Dead Sea. The name seems at times to have been applied to the whole range, and again limited to one of the summits. It is supposed to be identical with Mount Nebo (q.v.) 2,643 feet. It is not the highest peak of the range, but the one nearest to the place were the Israelites were encamped. From the summit may be seen (to the west) Samaria, Lower Galilee, as far as Tabor, and the chain of Gilboa. To the southwest may be seen the north half of the Dead Sea, the precipices of Engedi, and beyond, the desert of Judea.

PISISTRATUS, pĭ-sĭs'trą-tus, a notable Greek «tyrant» of Athens: d. about 527 B.C. He first appears as an educated well-to-do citizen of Athens, of most engaging manners and strong ambitions. He held a minor office at the time there were three parties in Greece: the party of the Plain, comprising the landed proprietors, then headed by Lycurgus; that of the Coast, or wealthy trading class, headed by Megacles; and that of the Highlands, mainly made up of the laboring population. The latter being the party that seemed most likely to further his designs, Pisistratus threw in his lot with it, and secured its allegiance by coming forward as patron and benefactor of the poor. In all his public speeches he was the advocate of civil equality and a democratic constitution. On one occasion he appeared in the market-place with several slight self-inflicted wounds, and called upon his fellow-citizens to protect him against certain alleged enemies, who had, as he said, attacked his life on account of his adherence to the democracy. A bodyguard of 50 men was voted him; this force he soon greatly increased, and made himself popular with his guard and bound them to serve him, and in 560 B.C. seized upon the acropolis. He was now master, or, as the Greeks termed it, «tyrant» of the city. The term was equivalent to the modern political «boss.» Solon had long recognized him as a dangerous man and a hypocrite, but his charges had been unheeded, and Solon departed from his enslaved country. But though a tyrant in the Greek sense, his use of power was by no means tyrannical. He was twice in exile, once for five years, once for 11, but regained his power. He forced many of the idle inhabitants to leave the city and cultivate the country around, which by these means was covered with corn-fields and olive plantations. Those who had no resources of their own he supplied with cattle and seed. He extracted from everyone the tenth part of his income and earnings, and thus increased the revenue of the state, which he expended in splendid public buildings. He established a public library, and collected and arranged the poems of Homer. Twice was he deposed and driven away, and twice he returned and assumed authority. The last time he came back with an army of Greek mercenaries whom he had attached to himself by developing some gold mines at Mount Pangæus, and spending the sums gained with great liberality. When he returned, about the year 540, thousands of his old supporters rallied about him, and he ruled from that date until his death, with great wisdom, and care to maintain his popularity. He kept the people at work, reduced the taxes of the agriculturists, improved the courts of law, and increased the prosperity of the state. He carried out many of the reforms proposed by Solon, whom he had virtually thrust out of office. As he well knew how tyranny was hated he carefully concealed his power under the exterior of a private citizen. He submitted like others to the jurisdiction of the Areopagus, before which he was accused of murder, and conducted himself with as much prudence as clemency. Consult the works by Flach (1885) and Töpffer (1886).

PISO, pī'sō, **Gaius Calpurnius**, Roman politician of the 1st century B.C. Cicero speaks very favorably of him as an orator. He became consul with Manius Acilius Glabrio in 67 B.C., and in 66–65 B.C. was proconsular administrator of Narbonese Gaul. Accused of extortion by Cæsar, he was defended by Cicero, whom he urged, to accomplish his own revenge, to bring charges against Cæsar as one of the Catilinarian conspirators.

PISO, Gnæus Calpurnius, Roman politician of the late 1st century B.C. and early 1st century A.D. He was consul with Tiberius (q.v.) in 7 B.C. and when the latter became emperor was employed to thwart Germanicus (q.v.) in all ways possible, to which end he received the command of Syria. It was thought at the time that he caused the death of Germanicus by poison. Tiberius was forced to sanction an investigation by the Senate; but before its termination Piso was found dead, whether by suicide or sacrificed by Tiberius to arrest popular indignation is uncertain.

PISO, Lucius Calpurnius, with agnomen **Frugi**, Roman statesman and historian of the 2d century B.C. He was tribune of the plebes in 149 B.C. and consul (with Publius Mucius Scævola) in 133 B.C. He opposed the corn laws, especially the *lex frumentaria*, of Gaius Gracchus. He wrote several orations and the 'Annales,' a history of Rome from the earliest period to his own time, none of which has survived.

PISO, Lucius Calpurnius, Roman politician of the 1st century B.C. and father-in-law of Julius Cæsar. The most of our information regarding him is obtained through Cicero, who depicts him in the darkest of colors. Inasmuch as the great orator was both a personal and a political enemy, some reasonable modifications of his estimate must be made. As consul in 58 B.C. (with Aulus Gabinius), he obtained Cicero's banishment (see CICERO) and in 57–55 B.C. as governor of Macedonia he certainly plundered the province most rapaciously. On returning from exile Cicero spoke his mind about him in the speeches 'De Provinciis Consularibus' and 'In Pisonem.' See CÆSAR.

PISO, Marcus Pupius, Roman orator and politician of the 1st century B.C. He held the prætorship at an uncertain date, was proconsular administrator of Spain and on his return thence in 69 B.C. received a triumph. In 61 B.C. he was consul (with Marcus Valerius Messalla Niger). In his earlier period an excellent forensic speaker and better versed than his predecessors in Greek literature, he was an instructor of Cicero.

PISOLITE, or **PEASTONE**, aggregated concretions, usually calcareous, about the size of peas. Upon being split open these globules show a concentric structure. They are sometimes made up of considerable beds of pisolitic limestone, which is particularly characteristic of certain parts of the Jurassic system.

PISSARO, pē-sä-rō, **Camille**, French artist: b. Saint Thomas, West Indies, 10 July 1830; d. Eragny, 12 Nov. 1903. He studied art under Melbye and Corot and his early work showed the influence of the latter. In choice of subject he is allied with Millet, though he does not invest his scenes of rustic life with the same pathos. In the luminous quality of light he surpassed Millet. This predilection for effects of light predisposed him to favor the departure of the so-called "impressionists" and about 1870 he allied himself with the group composed of Manet, Degas, Renoir, Claude Monet and a few others. After much ridicule the new departure won the day as a recognized method of technique. Though popular in France Pissaro's pictures are not so well known outside that country. Seven of his works hang in the Luxembourg. Special exhibitions were held at intervals in Paris after 1890. Views of Rouen, Paris and the country about Eragny besides studies made in London during a visit with Monet form his later subjects.

PISTACIA, a genus of trees of the family *Anacardiaceæ*. The 10 or a dozen species are natives of western Asia and the Mediterranean region, with one in Mexico. They have alternate, evergreen or deciduous leaves; small, apetalous, diœcious flowers in axillary racemes or panicles; and dry, drupaceous fruits with bony stones which split in two and expose the oily kernels. The pistacia — or pistachio — nut or tree (*P. vera*) is a native of western Asia but is cultivated in the Mediterranean region and other warm climates, including California. It grows about 20 feet tall, bears pinnate leaves and fruits about as large as olives. The kernels, known also as green almonds, are widely used for flavoring and coloring confectionery, ices, cakes, etc. The turpentine tree (*P. terebinthus*) yields Cyprian or Scio turpentine, a greenish-yellow, fragrant product which has been used by druggists and physicians since the days of Hippocrates. It is a native of the Mediterranean region, attains heights of about 30 feet and has pleasant oily fruits. It is cultivated to a small extent in the southern and southwestern United States. The batoum tree (*P. atalantica*), a native of northern Africa, grows about 40 feet tall, bears an edible fruit popularly used by the Arabs and an aromatic gum resin which is chewed as a dentifrice and breath perfume. The lentisk or mastic tree (*P. lentiscus*) yields mastic (q.v.), a gum resin, and the kernels of *P. oleosa* yield a fragrant oil used by the Orientals for perfuming ointments and other druggists' compounds. The tree is indigenous to eastern Asia.

PISTIL, *in botany,* the female organ of a phanerogamous flower, occupying almost invariably the centre of the flower. See FLOWER.

PISTOIA, pĭs-tō'yä, or **PISTOJA** (ancient PISTORIA), Italy, city in the province of Florence, about 20 miles northwest of the city of Florence. The city is noted for its fine specimens of early art and architecture. Verrocchio's first work in marble is said to be the monument to Cardinal Forteguerra, in the cathedral. The cathedral was built in the 12th century. A pulpit by Pisano is in the church of Saint Andrea. Other remarkable art productions are here; the ancient churches and palaces are well preserved and of great historic and artistic interest. In 62 B.C. Catiline was defeated here, and the name of the place occurs frequently in the history of the contentions between the Guelfs and Ghibellines. It is said to have received its name on account of firearms having been first made here. It has considerable manufactures of silk goods, firearms, glass, paper, iron and steel wares, linen and woolen goods. Pop. of commune about 70,000; town, 14,000.

PISTOL. See SMALL-ARMS.

PISTOLE, pis-tōl', a gold coin formerly in use in Spain, Italy, Switzerland and some parts of Germany. It was originally a Spanish coin and was equivalent to $3.65. One of the Italian pistoles is quoted as worth $5.55.

PISTON, in engines and motors, a device for reciprocating in a cylinder or tube, and receiving pressure from a fluid or gas, or delivering pressure. It is usually cylindrical or drum-shaped, so fitted as to fill the sectional area of a tube, such as a pump barrel, or the cylinder of a motor, and capable of being driven alternately in opposite directions, by the pressure of a motive fluid, or of being reciprocated by a crank and connecting rod, and thus compressing any gas confined in the cylinder. A piston requires to fit snugly in its tube or cylinder, and the usual device for fitting it tightly is called «packing,» but consists of a series of spring spiral rings that by their expansive tension fill the cylinder bore very accurately. A piston and cylinder with connecting rod and crank constitutes a mechanical motion fundamental in the building of reciprocating engines and motors. See CYLINDER; STEAM AND STEAM ENGINES; MOTOR; LOCOMOTIVE, THE.

The piston of a rotary pump takes a radically different form from the standard piston. It is really a swinging sector, called a piston, because it performs the work of a piston. It is usually a rectangular plate, arranged to rock on a centre, and fill the cross section of a sector, in which it moves and forces the containing fluid.

PIT AND GALLOWS, a term now obsolete, formerly, in feudal times, a privilege granted to barons by the Crown, in virtue of which they were empowered to hang on a gallows men convicted of theft or other crimes, and to drown in a pit or well women guilty of those crimes.

PIT-RIVER INDIANS, the name given several small American tribes of the Palaihnihan family residing along the Pit River in northeastern California. The river received its name from the tribal custom of digging deep pits or windfalls for capturing deer and other animals. These Indians are of a very inferior type, mentally and physically, and were formerly very warlike and hostile. About 1,000 of them roam about the Pit River region refusing to reside on the Indian reservations.

PIT VILLAGES, collections of earth caves, dug in the ground and covered with stones, wood, clay or sods of turf. They were used by prehistoric races or by races of the lowest stages of barbarism. A good example was unearthed during the latter half of the 19th century near Andover, in Hampshire, England. The pits are reached by entrance shafts, sloping downward. The pits themselves are oval or pear-shaped, varying between 22 and 42 feet in length, and are about 12 or 13 feet wide and five feet high, with the fire-place in the centre. Flint and bone implements and rude pottery have been found in them.

PIT-VIPER, a venomous viperine snake of the family *Crotalidæ* or subfamily *Crotalinæ*, prominently represented by the rattlesnakes, and characterized by a deep pit between the eye and the nostril, the function of which, if it has any, is not known. See VIPERS; RATTLESNAKE.

PITA. See FIBRE.

PITAKA, pĭt'ą-ką, in the sacred literature of the Buddhists, any one of *tripit'aka* meaning the three great divisions of canonical works, which, and collectively, constitute the whole Buddhistic code. The *Sutta-Pittaka* embodies the philosophy and traditions of the Buddhists. There are five books and 15 parts. The *Vinaya-Pitaka* deals with discipline and includes five books; the *Abhidhamma-Pitaka,* of seven books, discourses of metaphysics, the elements, manifestation, and enumerates personal duties.

PITAVAL, John Baptist, American Roman Catholic archbishop: b. France, 10 Feb. 1858. His preliminary studies for the priesthood were made in the archdiocese of Lyons, France. In June 1881 he came to the United States and entered Saint Mary's Seminary, Baltimore, being ordained a priest by Rt. Rev. Joseph P. Marchebeuf in Denver, Colo., 24 Dec. 1881. For 21 years he devoted himself to missionary work in Colorado and on 25 July 1902 was consecrated titular bishop of Sora and auxiliary bishop of Santa Fé. When this see became vacant on the death of Archbishop Bourgade in May 1908, Bishop Pitaval was named administrator of the archdiocese of Santa Fé, which office he filled with eminent success, being nominated archbishop of Santa Fé by His Holiness Pius X on 3 Jan. 1909.

PITCAIRN, pit'kārn, **John,** Scotch soldier: b. Fifeshire, about 1740; d. Boston, Mass., 17 June 1775. He seems to have been a soldier from his youth; was promoted to be captain of marines in 1765 and to be major in 1771; was stationed in Boston about 1772; and was popular there because of his just treatment of complaining colonists. He led the advance guard of the force sent from Boston to Concord 19 April 1775, met the minute men at Lexington, ordered them to disperse, and took part in the resulting battle, which is commonly believed to have been begun by his orders to fire, though his own story was that the minute men fired first. Pitcairn played a prominent part in the battle of Bunker Hill, was the first to mount the breastworks and was mortally wounded by a negro as he was crying "Now for the glory of the marines."

PITCAIRN, Pa., borough in Allegheny County on the Pennsylvania Railroad, 15 miles east of Pittsburgh. It is a thriving industrial centre, with extensive railroad shops and yards, foundries, machine shops and electrical-supply works. Coal-mining is also an important industry and gives employment to many. The borough owns the electric-lighting plant. Pop. 4,975.

PITCAIRN ISLAND, a British possession in the Polynesian Islands, belonging to the Low Archipelago, in lat. 25° 5′ S.; long. 130° 5′ W., about two miles long and one mile wide. Its coast is almost perpendicular and is fringed with rocks and reefs, making it impossible to land except at a few points. The interest which attaches to this island is derived from its history; it was discovered by Carteret in 1767 but was uninhabited till 1790, when nine British sailors, mutineers of the British ship *Bounty,* together with 18 natives of Tahiti, 6 men and 12 women, landed on this island. Their subsequent contentions resulted in murders and various crimes. After 10 years John Adams (q.v.) and a few survivors were left. His reform and his manner of teaching and supervising the little colony led to a complete change. They became peaceable, moral and industrious. He had saved a Bible from the ship and ruled his little kingdom with wisdom and justice. An American sealing ship visited Pitcairn in 1808 and H. M. S. *Britain* in 1815. The British Crown took formal possession in 1839. In 1856 the community (194 in number) was removed to Norfolk Island, Pitcairn having become too small for their comfortable subsistence. Some of the number, about 40, returned to Pitcairn. In 1911 there were on the island 145 persons (40 adult males, 45 adult females, 43 children aged 6 to 16, and 17 infants under 6). In religion the islanders are Seventh Day Adventists. A recent colonial office report describes the people as having degenerated from their former manner of living. The products of the island are sweet potatoes, beans, sugarcane, yams, taro, melons, oranges, bananas, pineapples and arrowroot. Excellent coffee also grows. There are on the island about 200 wild goats and a small stock of chickens. The local government is administered by a council of seven members, with a president, who acts also as chief magistrate, and a vice-president, who is also government secretary, subject to the control of the high commissioner for the western Pacific. See Bligh, William.

PITCH, a thick, sticky, dark, resinous substance with brilliant lustre, obtained from the various kinds of tar produced in the destructive distillation of wood, coal, etc. Pitch is extensively used in ship-building, etc., for closing up seams, also for keeping wood from speedy decay, or iron railings from rusting when exposed to the weather. Natural pitch, as that found in the noted pitch lake in Trinidad, is formed of the dried flow of petroleum. The residue of petroleum in refining also yields tar, and in gas making tar is formed as a by-product. Pitch and tar are chemically the same, but the term pitch is used mainly for the product from the southern pines and natural deposits in pitch lakes. See Tar.

PITCH, *in mechanics,* inclination, slope; *in architecture,* the rise, or versed sine of an arch; *in carpentry,* the inclination of a roof. The point or degree of elevation is also termed pitch. Musical sounds give to the mind a feeling of acuteness or gravity according to the rapidity or slowness of the vibrations producing them; hence, the former are called acute or high, the latter grave or low. See Music.

PITCH AND HITCH, a game for ten players, five on a side, usually played indoors. Disks of galvanized metal are pitched from a distance of ten yards into a receiver, a round rubber dish, having an opening at the top five inches in diameter. The game is similar to that of quoits (q.v.), the courts being the same.

PITCH LAKE. See Trinidad.

PITCH AND TOSS, a game played by throwing up a coin and calling heads or tails; hence, to play pitch and toss with anything is to be careless or wasteful about it; to play ducks and drakes.

PITCHBLENDE. See Uraninite.

PITCHER, Moll, American heroine. She was the wife of a soldier in the Continental army and at the battle of Monmouth, 28 June 1778, saw her husband killed in the act of firing a cannon. She at once took his place, fired the already loaded cannon, and fought throughout the day. She was praised by Washington who commissioned her a sergeant in the army.

PITCHER, Thomas Gamble, American soldier: b. Rockport, Ind., 23 Oct. 1824; d. Fort Bayard, N. Mex., 21 Oct. 1895. He was graduated from West Point in 1845, served in the Mexican War and for gallantry at Contreras and Churubusco was in 1847 brevetted 1st lieutenant. He served on the frontier until the outbreak of the Civil War, defended Harper's Ferry in 1862 and later served in the Virginia campaign. From 1863–65 he was provost-general-marshal, and in the latter year brevetted brigadier-general in the regular army for services throughout the war. He was mustered out of the volunteer service in 1866 and commissioned colonel of the 44th Infantry. In 1866–71 he was superintendent at West Point, governor of the Soldiers' Home near Washington in 1871–77, and in 1880–87 superintended the New York Soldiers and Sailors' Home.

PITCHER, Zina, American physician: b. Washington County, N. Y., 1797; d. 1872. In 1822 he was graduated at Middlebury College and soon afterward was appointed assistant surgeon in the army. In 1835 he was president of the Army Medical Board. After 15 years, connection with the army medical service, he resigned and established a medical practice in Detroit. He was thrice mayor of Detroit; was president of the Michigan Medical Society in 1855–56 and of the American Medical Association in 1856. He also served as regent of the University of Detroit. He was also for three years editor of the *Peninsular Medical Journal.*

PITCHER-PLANTS, plants whose leaves resemble pitchers. These pitchers, which are more or less filled with water, are thought to act as plant-food gatherers, especially of nitrogenous food, which they are believed to digest from the bodies of entrapped insects. Generally they have lids whose office is to keep out rain; honey-secreting glands, which attract insects; downward pointing hairs or bristles which permit the visitors to crawl down in the pitchers but prevent their return; digestive and even pepsin or enzyme-containing secretions which act upon the soft parts of the insects' bodies. After the nectar-hunting insects have finally begun to decompose, the odor of decay frequently attracts carrion-feeding insects so the plants may be said to have two harvests.

Mosquitoes have been known to breed in the water contained in the pitchers.

The best-known kinds are the species *Nepenthes* (family *Nepenthaceæ,* of which about 50 tropical species, mostly Malayan, have been described. These are the pitcher-plants seen in greenhouses, the pitcher pendant upon the ends of rather narrow leaves. Two genera of these plants are American. The pitcher-plants or «side-saddle flowers» of the swamps east of the Rocky Mountains, especially well-known east of the Mississippi River, belong to the genus *Sarracencia.* The other genus has only one species (*Darlingtonia californica*), which is found only at high elevations of the Pacific Coast. *Heliamphora nutans* is a unique species found in northern South America. These three genera constitute the family *Sarraceniaceæ. Cephalotus follicularis* is an Australian plant with pitchers resembling those of *Nepenthes,* but it belongs to a different family.

PITCHSTONE, a glassy volcanic rock, assumed to resemble hardened pitch, but of any color. It is translucent on thin edges and breaks with a conchoidal or splintery fracture. It occurs in the form of dikes and as lava-flows and may be considered as a natural glass formed by the rapid cooling of those lavas of which common feldspar (orthoclase) forms a considerable part. Sometimes it is spherulitic, the spherules, which are occasionally of large size, showing a fibro-radial structure. It is found chiefly in Mexico, South America and southern Europe.

PITH, the cylindrical or angular column of cellular tissue at or near the centre of the stem of a plant, also called the medulla, of which a good example is afforded by studying Chinese rice paper, made from the pith of the *Aralia papyrifera.* The pith is at first succulent and of a greenish color, afterward it becomes dry, and in many plants its cells are broken up, leaving large cavities. In its primary state it appears to be a reservoir of nourishment for the embryo plant. See ANATOMY OF PLANTS.

PITHECANTHROPUS ERECTUS, (erect ape-man), the name given by Dr. Eugene Dubois to the fossilized remains found by him in Java in 1891–92. These consist of the upper part of a cranium, a left femur and two molar teeth, and indicate a high order of ape, closer to man than any previously noted of Pleistocene ages. Much doubt and discussion was aroused at first in regard to it but the weight of scientific opinion is now that it was either an ape or a man, or that the bones became mixed, hence that there is no «missing link». The animal when erect must have stood 5½ feet high, «and the contents of the cranium,» says Beddard, «must have been 1,000 cm.. that is to say 400 cm. more than the cranial capacity of any anthropoid ape, and quite as great or a trifle greater than the cranial capacity of some female Australians and Veddahs; but as these latter are not five feet in height, the ape-like man had really a less capacious cerebral cavity.» The skull in form and capacity stands roughly midway between that of a young chimpanzee (with no crest), and that of the lowest human example known — the man of Neanderthal. Consult the discoverer's monograph, ‹Pithecanthropus erectus› (Batavia 1894, in German); reprinted in English in ‹Smithsonian Report› for 1898; Haeckel and Gadow, ‹The Last Link› (1898); and Beddard, ‹Mammalia› (1901).

PITHOM, pī'thŏm, a town of northern Egypt, in the land of Goshen, built for Rameses II by the children of Israel (Exod. i, 11), as a storage city to supply his Asiatic armies. The town was discovered at Tell el Maschulah, between Ismailia and Tell el Kebir in 1882, and its ruins explored by Dr. Naville (1882–83). A statue of Rameses II was unearthed as well as of other monarchs of up to the 22d dynasty to the time of the Ptolemies. Consult Naville, ‹The Store-city of Egypt and the Route of the Exodus› (1888).

PITKIN, Timothy, American lawyer and historian: b. Farmington, Conn., 21 Jan. 1766; d. New Haven, Conn., 18 Dec. 1847. He was graduated at Yale in 1785; became a lawyer and a leader of the Connecticut Federalists, who elected him to Congress in 1805; served there for 14 years; and was one of the earliest political historians of the United States. He wrote ‹Statistical View of Commerce of the United States of America› (1816), and ‹Political and Civil History of the United States of America from the Year 1763 to the Close of Washington's Administration› (1828).

PITMAN, Benn, American phonographer: b. Trowbridge, Wiltshire, 24 July 1822; d. Cincinnati, Ohio, 28 Dec. 1910. He was educated in the academy of his brother, Sir Isaac Pitman (q.v.), and for 10 years engaged in lecturing on and teaching phonography in England. In 1853 he came to this country and established the Phonographic Institute at Cincinnati, Ohio, of which he was long president. His latter teaching differed in several particulars from that of his brother. He was military recorder of State trials during the Civil War, invented the electro-process of relief engraving, and in 1873–92 was lecturer on art and teacher of artistic wood-engraving in the Cincinnati Art Academy. He has published 'Manual of Phonography' (1854); 'History of Shorthand' (1858); 'A Plea for American Decorative Art' (1895); 'Phonographic Dictionary' (1899).

PITMAN, Sir Isaac, English phonographer; b. Trowbridge, Wiltshire, 4 Jan. 1813; d. 22 Jan. 1897. He was educated in London at the Normal College of the British and Foreign School Society, and in 1832 was appointed master of the British school at Barton-on-Humber. In 1837 he published 'Stenographic Sound-Hand' which under the present title of phonography or stenography has become so widely used as to practically extinguish the earlier systems. It is claimed that he first suggested the postage stamp as a convenient way of paying postage. The *Phonographic Journal*, afterward named the *Phonetic Journal*, was established by Pitman in 1842, and for a period of more than 50 years was personally edited by him. He issued numerous revised manuals and over 200 works in his system of shorthand, consisting of standard and general literature, ranging from the complete Bible to the Vicar of Wakefield, etc. His 'Shorthand Instructor,' was extensively adopted by commercial and high schools and the Pitman system will always be remembered as fundamental in shorthand. In 1894 Pitman was knighted by Queen Victoria for «his eminent services to stenography.» He died after having witnessed the introduction of his shorthand into every English-speaking country. For a description of his system, the one most generally used by expert practitioners, see SHORTHAND. Consult 'Life,' by Benn Pitman.

PITNEY, Mahlon, American jurist: b. Morristown, N. J., 5 Feb. 1858. In 1879 he was graduated at Princeton University and in 1882 was admitted to the bar and practised at Morristown. From 1895 to 1899 Mr. Pitney was a member of Congress and in 1899–1901 was a member of the senate of New Jersey. In 1901–08 he was associate justice of the Supreme Court; in 1908–12 he was chancellor. In the latter year Justice Pitney was elevated to the Supreme Court of the United States in succession to Justice Harlan. He allied himself with the conservative group of the Supreme Court.

PITRI, in Hindu mythology, one of several orders of divine or spiritual beings. According to one of the Vedic accounts the older manes or deceased ancestors of mankind were pitris, and a great deal is written about the Lunar pitris. The tar prajapatis are also alluded to as pitris; they were creators of the human race, and included ancestors of demons. For a full understanding of the term consult Besant, A., 'Ancient Wisdom' (1892); Sinnett, 'Esoteric Buddhism' (1883).

PITT, William, English Parliamentary orator and statesman: b. Hayes, near Bromley, Kent, 28 May 1759; d. Putney, 23 Jan. 1806. He was the son of the Earl of Chatham (q.v.). In 1773 he entered Pembroke Hall, Cambridge, where his knowledge of mathematics and the classics seems to have astonished ripe scholars. His acquaintance with modern literature was slight. Of living languages besides his own he was almost entirely ignorant; an imperfect knowledge of French was all he possessed. His whole education was directed to the end of making him a great Parliamentary orator. In 1778 he entered Lincoln's Inn, and in 1780 was called to the bar. He attended the western circuit once and was introduced into Parliament by Sir James Lowther, as representative for his borough of Appleby. His maiden speech was delivered in support of Burke's financial reform bill. On the failure of Fox's India bill, which produced his dismissal of the North and Fox coalition ministry, Pitt, although at that time only in his 24th year, assumed the station of Prime Minister by accepting the posts of First Lord of the Treasury and Chancellor of the Exchequer. Although strongly supported by the sovereign, he stood opposed to a large majority of the House of Commons, and with the exception of Henry Dundas (q.v.), every other prominent debater in the House was against him. In spite of many defeats in the Commons he refused to dissolve Parliament or resign, until, having at last obtained a majority, he fixed the day (24 March 1784) on which the king dissolved Parliament.

At the general election which followed the voice of the nation appeared decidedly in his favor, and some of the strongest interests in the country were defeated, Pitt himself being returned by the University of Cambridge. His first measure was the passing of his India bill, establishing the board of control, followed by much of that fiscal and financial regulation that gave so much *éclat* to the early period of his administration. The establishment of the delusive scheme of a sinking fund followed in 1786. In 1788 Pitt resisted the doctrine of the opposition that the regency, during the king's indisposition, devolved upon the Prince of Wales by right. The minister maintained that it lay in the two remaining branches of the legislature to fill up the office, but that the prince could not be passed over in nominating to this post. By the adoption of this principle he was enabled to pass a bill restricting the regent's power, which the king's recovery rendered unnecessary. The French Revolution now broke out, and in 1793 war arose between Great Britain and France. Great Britain was successful by sea, but during the life of Pitt the conflict on the Continent was in favor of France. In 1800 the Irish union was accomplished. In 1801 the opposition of the king to all further concessions to the Irish Catholics caused Pitt to resign his post. The Peace of Amiens succeeded; and the Addington administration, which concluded it, Pitt supported for a time, and then joined the opposition. The new minister, who had renewed the war, unable to maintain his ground, resigned; and in 1804 Pitt resumed his post at the Treasury. Returning to power as a war minister, he exerted all his energy to render the contest successful, and found means to engage the two great military powers of Russia and Austria as well as Sweden in a new coalition, which was dissolved by the battle of Austerlitz. Pitt, whose state of health was previously declining, was sensibly affected by this event, as he was also by the Parliamentary attack upon his old associate, Lord Melville (see DUNDAS), not wholly parried either by ministerial influence or the merits of the case. Pitt has been much criticised as a war minister, but with great evident injustice. He wisely saw that the war on England's part must be naval. He formed coalitions with Continental powers that were to act on land. He met the demands of these powers by large subsidies. If the coalitions failed, as they did fail, Pitt was not responsible for the self-seeking of his Continental allies. In peace he sought Parliamentary reform, strengthened the national credit, established an improved financial system and followed a successful commercial policy. He was altogether above the meanness of avarice, his personal disinterestedness being extreme. His eloquence, if not more elevated or profound, was, upon the whole, more correct than that of any other orator of his time, and his language was remarkably copious and well arranged. On the whole Pitt was a minister of commanding powers. A public funeral was decreed by Parliament, and a grant of £40,000 to pay his debts. Consult Lord Stanhope's 'Life of Pitt' (2d. ed., 1862); Sergeant, 'William Pitt' (1882); Walford, 'William Pitt: a Biography' (1890); Rosebery, 'William Pitt' (in 'Twelve English Statesmen,' 1891).

PITT, William (1708–1778). See CHATHAM, EARL OF.

PITT, William (1773–1857). See AMHERST, WILLIAM PITT.

PITT, Diamond. See DIAMONDS.

PITT, Fort. See PITTSBURGH.

PITTACUS, one of the seven Grecian sages: b. about 650 B.C., d. 569. He assisted in the overthrow of the tyrant Melanchrus, led the Mytilene forces against the Athenians in a contest for Troad coast territory, slaying Phryno in single combat. He was raised to the dictatorship, and ruled successfully for 10 years. He wrote poems and originated the truism, «It is hard to be good.»

PITTI (pĭt'tē) **PALACE,** a celebrated Florentine palace, the second in size in the world. See FLORENCE.

PITTMAN, Key, American legislator: b. Vicksburg, Miss., 19 Sept. 1872. He was educated by private tutors and at Southwestern Presbyterian University, Clarksville, Tenn. In 1892 he established a law practice at Seattle, Wash.; joined the movement to the Klondike in 1897; worked as a common miner for two years and served as counsel for Australians who attacked the corruption of government officials at Dawson. He went to Nome in 1899 and participated in the organization of a «consent» form of government, became first district attorney there, and was one of the leading counsel for miners in their fight against a conspiracy to rob them of their mines in 1901. He removed to Tonopah, Nev., in 1902 and acquired a large mining and corporation practice. In November 1912 Mr. Pittman was elected United States senator by popular vote, subsequently confirmed by the legislature, for the unexpired term (ending 4 March 1917) of G. S. Nixon, deceased. He was re-elected for the term 1917–23.

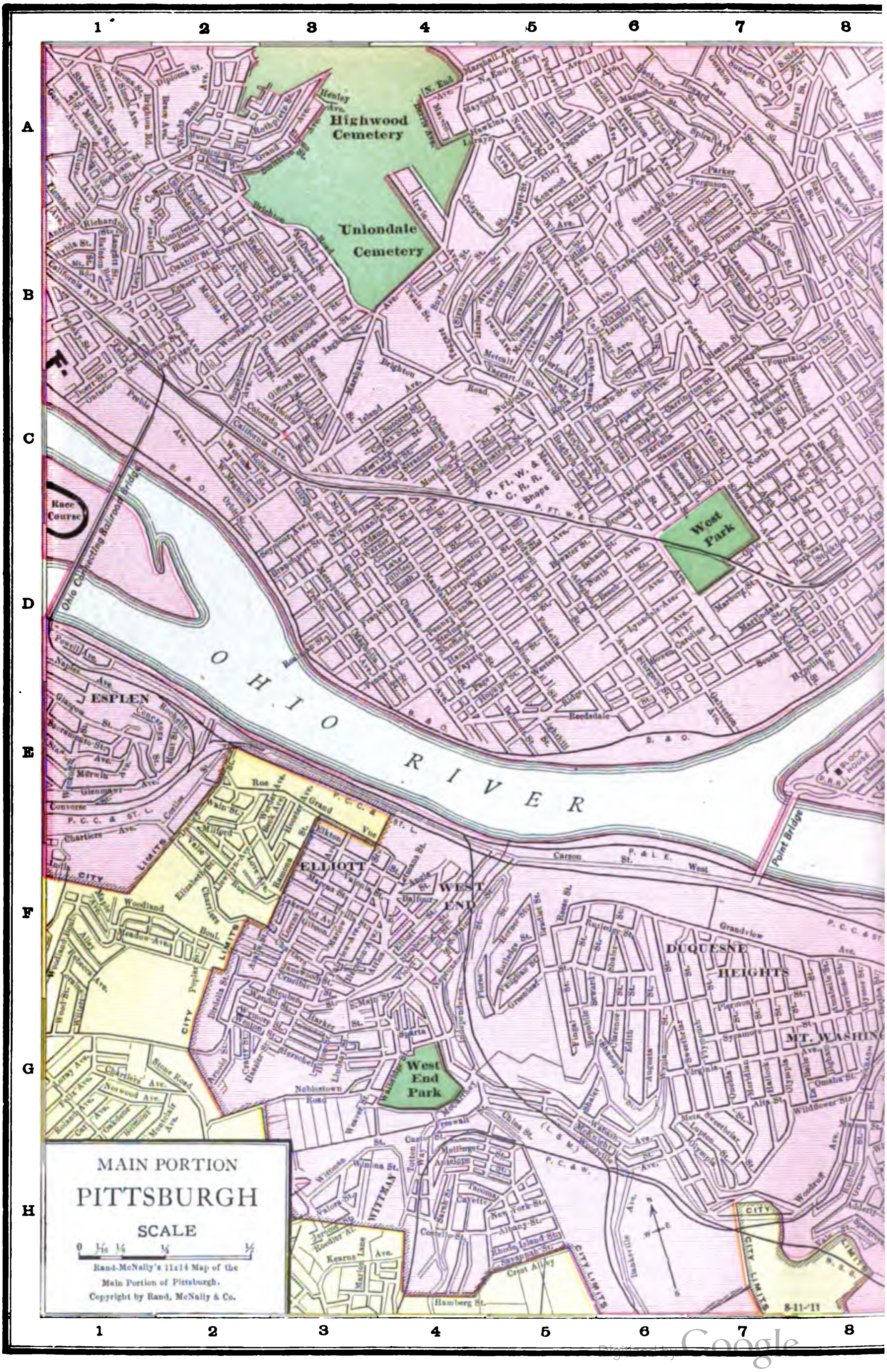
PITTSBURG, Kan., city in Crawford County, on the Saint Louis and San Francisco, the Kansas City Southern, the Atchison, Topeka and Sante Fe and the Missouri Pacific railroads, about 125 miles south of Kansas City. It was settled in 1876 by colonies from the Eastern and Southern States; incorporated as a city of the third class the same year, a city of the second class in 1880, and first class city 9 Nov. 1906. It is in a productive agricultural region, and has considerable manufacturing interests. The chief manufacturing establishments are the Kansas City Southern shops, foundry and machine shops, one brick plant, packing-house, planing mill, artificial ice plants, electric-power plant, tile works, three zinc smelters, flouring mill, elevator, hat factory, candy factory, knife factory and boiler works. About 2,000 men are employed in industries in the city, and about 600 men, who live in the city, are employed in the coal mines in vicinity. There is a large trade in manufactured goods, coal and farm products; coal is king. The educational institutions are the State Manual Training Normal School, a high school, five ward schools, one parish school and a public library. There are 13 churches, and five banks, one denominational hospital, also a Y.M.C.A. The banks have a combined capital of $500,000 and deposits $3,500,000. The govenment is commission form with five commissioners elected by the city for a period of two years. Pop. 19,100.

PITTSBURGH, Pa. (incorrectly spelled «Pittsburg,» *Pittsburgh* being the true name of the city, originally given to it, used on its great seal from the date of its incorporation and legalized by joint resolution of Congress), the metropolis of the Ohio Valley and county-seat of Allegheny County, Pa., is located at the junction of the Monongahela and Allegheny rivers, which here unite to form the Ohio in lat. 40° 30′ N., long. 80° W. (Greenwich). The three rivers flow through deep valleys of erosion, which have been excavated by them and the high lands on their sides are broken into a great number of hills, separated by deep ravines, also caused by erosion in past ages. In its topography the city presents a marked contrast to many other cities, which are built upon comparatively level ground. Rome had her «Seven Hills»; it is no exaggeration to say that Pittsburgh has her «Seventy Hills.» The most important of these eminences in the area between the Allegheny and the Monongahela are Grant's Hill upon the summit of which are located the Allegheny courthouse, the city and county building, and some of the great office buildings which have been erected in recent years; Boyd's Hill topped by the buildings of Duquesne University; Herron Hill, upon the summit of which is one of the great reservoirs and upon the southern face of which are the new buildings of the University of Pittsburgh; Squirrel Hill, an irregular uplift, rising 500 feet above the level of the rivers and upon which are built some of the more beautiful residences of the city. Between the high ridge of the Squirrel Hill district, which overlooks the Monongahela River, and the equally lofty elevations along the Allegheny River, upon the summit of one of which is Highland Park, lies the East Liberty Valley, densely populated containing many palatial residences and near the East Liberty station of the Pennsylvania Railroad, rapidly developing into an important business centre, beginning to be invaded by «sky-scrapers,» which are so characteristic of the older part of the city. The «North Side» of Pittsburgh, formerly the city of Allegheny, occupies a comparatively level tract along the Allegheny and the Ohio rivers, broken nearly opposite «The Point,» where the rivers unite, by Monument Hill, so called because it is surmounted by the Soldiers' Monument erected at the close of the Civil War. This low-level area, upon which the city of Allegheny had its beginning, is flanked to the west of the Allegheny and to the north of the Ohio by lofty heights, rising from 500 to 750 feet above the level of the rivers, up the sides and over the tops of which the city has crawled. On these breezy hill-tops are some of the most beautiful residential neighborhoods, and here is Riverview Park near the entrance of which stands the Allegheny Astronomical Observatory. Immediately overlooking the old city and rising hundreds of feet above it is Mount Washington, from which on a clear day there is a fine panoramic view of the greater part of the older portions of the city. The wall of the canyon of the Monongahela recedes sufficiently from the river to allow of the location upon level ground of that part of the city which once was «The Borough of Birmingham,» but which is to-day commonly known as «The South Side.» Back of this level ground rise a number of high, flat-topped hills, rapidly becoming densely populated and in common parlance known as «The South Hills District.» This territory is reached by rising tunnels, inclined planes, and by electrical tramways, which wind up with many devious turns through the ravines to the level summits.

Over 30 boroughs and townships have already been absorbed into the city, and the names of these still in many cases cling to them. When a Pittsburgher speaks of going «into the City,» he means that he is going to that part of the great municipality forming the small triangle «at the Point,» where the city had its beginning. The area outside of this is cut up into a multitude of districts, which still bear old names — Soho, Oakland, Bellefield, Shadyside, East Liberty, Brushton, Lawrenceville, Manchester, Birmingham, Knoxville, etc. The stranger, visiting the place, unless he take pains to inform himself, is apt to be bewildered by these names, which are in common use, and will be as much puzzled as a visitor to London or Boston, cities also formed by a process of gradual absorption.

Area and Population.— At the time of its first incorporation the city was confined to the small triangle at the confluence of the Monongahela and Allegheny rivers, bounded on the east by Grant's Hill, so named after Major Grant of Forbes' army, who was defeated and lost his life in an encounter with the French, a few days before the capture of the spot by Forbes. The area of this site was only 320 acres, or less than half of a square mile. In 1909, at the time of the absorption of Beechview Borough, the latest addition to the city, its territory had expanded to 26,465 acres, or 41.35 square miles. The greatest territorial addition occurred on 30 June 1868, when six adjacent townships were annexed, they having an area of 13,568 acres. The greatest single increment in the population was made when, on 7 Dec. 1907, the city of Allegheny, having more than 150,000 inhabitants, was merged into the city of Pittsburgh. The population ascertained by the United States census of 1910 was 533,905; an estimate made by the Bureau of the United States census in July 1918 gave a population of 596,303. This is, however, very far from truly representing the urban population found in the locality known as Pittsburgh. The city is growing and expanding on all sides beyond its comparatively narrow municipal limits and in the immediate suburbs there are almost as many people as within its legally defined boundaries. Within a radius of 10 miles of the tower of the Pittsburgh courthouse there are over a million of people and as a «Metropolitan Centre,» according to the last United States census, Pittsburgh holds the fifth place in the United States, being outranked by only New York, Chicago, Philadelphia and Boston, in the order given. As in all of the larger industrial centres of North America, the population of Pittsburgh contains a very large percentage of the foreign-born, attracted to the spot by the opportunity to find remunerative employment. There are many Hungarians, Poles, Slovaks, and Ruthenians in Pittsburgh, and these are even exceeded in number by the Italians and Germans. There are in the neighborhood of 10,000 Greeks in the city and a considerable number of Belgians. The foreign element is largely drawn from those regions of the Old World in which mining and glass-working prevail. Since 1914 there has been a large influx of negroes from the Southern States.

Transportation Facilities.— The three rivers which traverse the city are important waterways and provide within the limits of the city proper a water-frontage of more than 40 miles. The Monongahela by the construction of dams and locks has been made navigable for a distance of more than 100 miles to the south and access is thus gained to the immense coal-fields of the northern part of West Virginia. The Allegheny is being canalized in the same way and thus the oil- and coal-fields of the upper counties of western Pennsylvania are being reached. By the Ohio the door is opened to thousands of miles of navigable water in the west and the south and access is had to the Gulf of Mexico and the oceans of the world. There is a large river traffic between Pittsburgh, Cincinnati, Saint Louis and New Orleans. In the early years of the last century, Pittsburgh was an important shipbuilding centre and before the days of such gigantic craft, as now sail the seas, many wooden ships, which in those days were esteemed of large size, were built in Pittsburgh and, passing down to the Gulf, entered into maritime commerce. At so late a period as that of the Civil War, smaller vessels were constructed here and a number of the early «Monitors,» among them the *Miantonomah* and sister ships, were launched from Pittsburgh ways. Even now the building of stern-wheel riverboats and marine engines is an important industry and craft of this description built and engined in Pittsburgh are being constructed for use upon the rivers of both Americas, upon the Volga, the Danube, the Yangtse, and the Kongo. In quite recent years the construc-



MAIN PORTION
PITTSBURGH
SCALE

Rand-McNally's 11x14 Map of the Main Portion of Pittsburgh.
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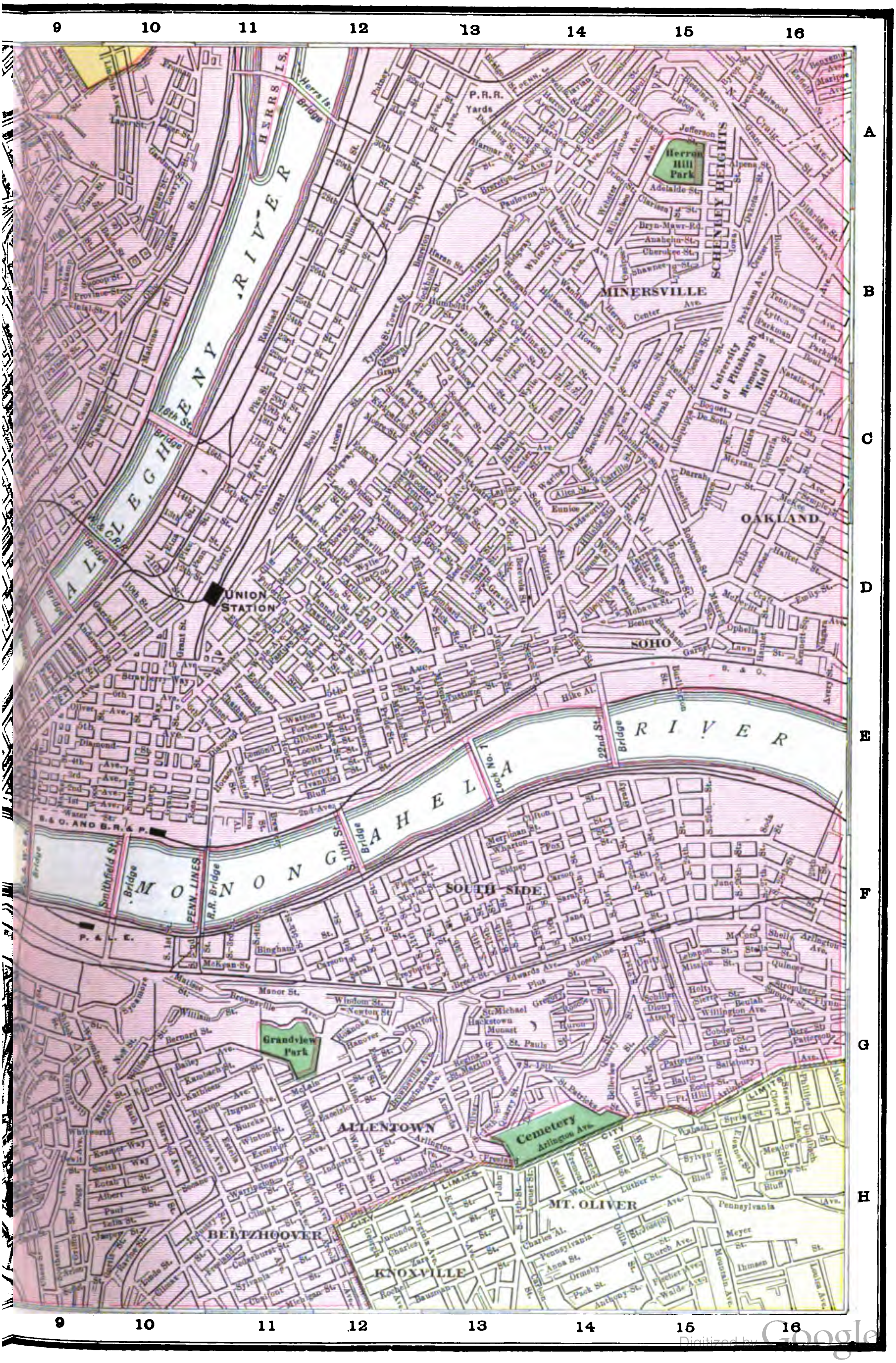
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ALLEGHENY RIVER
HERRS IS.
Herrs Is. Bridge
16th St. Bridge
P.R.R. Yards
Herron Hill Park
SCHENLEY HEIGHTS
MINERSVILLE
University of Pittsburgh
Memorial Hall
OAKLAND
UNION STATION
SOHO
B. & O.
MONONGAHELA RIVER
22nd St. Bridge
Lock No. 1
S. 10th St. Bridge
R.R. Bridge
PENN. LINES
Smithfield St. Bridge
B. & O. AND B. R. & P.
P. & L. E.
SOUTH SIDE
Grandview Park
ALLENTOWN
Cemetery
Arlington Ave.
CITY LIMITS
MT. OLIVER
BELTZHOOVER
KNOXVILLE

tion of steel barges for the transportation of coal has become an industry of magnitude. The harbor of Pittsburgh by the erection of the Davis Island Dam on the Ohio River has been made navigable throughout the year and here assemble the great "coal-tows," which at times of flood descend the Ohio to the Mississippi and. go south to the Gulf. The word "tow" as applied to these assemblages of huge coal-laden barges is a misnomer, though in constant use. The barges are assembled in front of the propelling craft, a stern-wheel steamboat, and are *pushed* rather than "towed" along their course.

The facilities for transportation by water have been during the past 70 years enormously supplemented by the construction of railways. At the present time there are 14 different steam-railways entering the city, connecting with all the railway systems of the country. The location of Pittsburgh as a point for the assemblage and distribution of merchandise is thus very favorable and the city is within one night's ride of half the population of the United States at the present time. Its central position is shown by the following scale of distances: to Wheeling 67 miles; to Cleveland 150 miles; to Buffalo 270 miles; to Washington 290 miles; to Baltimore 334 miles; to Philadelphia 340 miles; to New York 431 miles; to Chicago 468 miles. By express trains the most distant of these points is reached in less than 12 hours.

Travel within the city and the adjacent suburbs is facilitated by lines of electric railways radiating in every direction and extending far through western Pennsylvania, West Virginia and eastern Ohio. There are in the city 772 miles of streets and boulevards and 335 miles of ways and alleys under 20 feet in width, or a total of 1,107 miles of thoroughfares. The boulevards are kept free from rails and are the main arteries of communication by automobile. Owing to the peculiar topography, Pittsburgh has probably more bridges and viaducts than any other city in the world. There are 114 bridges and viaducts within the city proper, not counting railway bridges, of which there are seven. Almost every style of construction known to the engineering profession is represented by them. The Bloomfield bridge, connecting the Herron Hill district with the Bloomfield district, spans a deep valley and has a length of 4,962 feet, 6 inches. The Manchester bridge, spanning the Allegheny at its confluence with the Ohio, has a length of 3,257 feet. The Larimer Avenue viaduct at the time it was built was the longest single arch of reinforced concrete in the world, having a span of 312 feet, at its centre 125 feet above the bottom of the ravine which it crosses. Since it was built one or two others of larger span have been constructed, one of these in Australia. One of the interesting means of communication between certain parts of the city which excites the curiosity of visitors are the inclined planes, built to carry passengers and vehicles. There are a number of these, which enable a quick ascent to be made from lower to higher levels, without long detours. One of the best known of these is the Mount Washington Incline, opposite the Pittsburgh and Lake Erie Railroad station, by which in a minute the passenger is lifted 400 feet above the level of the old city and finds himself in a city literally "set upon a hill," looking down upon the steeples and "sky-scrapers" far below.

The tonnage of Pittsburgh, owing to the character of the commodities in which it deals, is very large and exceeds that of any other city in the world. Coal, ores, iron, steel and other heavy articles constitute much of what the city receives and sends out. At the present time the tonnage handled by rail and water exceeds 175,000,000 tons annually, twice that of New York, London, Liverpool and Marseilles combined, the aggregate of these in 1917 having been 84,376,000 tons. The rail traffic is represented by nearly 1,000 passenger and freight trains daily arriving or departing.

Manufactures and Mining.— Pittsburgh is located at the heart of the largest and most productive coal-field on the continent. Until the recent discoveries in the Southwest and Mexico, Pittsburgh was the centre of the most productive oil-fields in North America, which still have a great production. She has at hand one of the most extensive and richest fields of natural gas in the world. Pittsburgh annually uses in her grates and furnaces over 100 billions of cubic feet of natural gas, piped in the city through nearly 6,000 miles of gas-pipes, which reach out in every direction through western Pennsylvania and into West Virginia. The abundance of cheap fuel at her command has made the city the natural centre of all those industries which depend upon fire for their successful prosecution. She is the hearth of the nation, at which the spirit of Tubal Cain ministers to the wants of man. She used to be called "The Iron City," to-day she is called "The City of Steel." The Pittsburgh district annually produces more than one-half of all the coke manufactured in the United States and 10 per cent of all the bituminous coal mined in the world. Three-tenths of all the pig iron produced in the western hemisphere is made in Pittsburgh and four-tenths of all the steel; and the combined production of these commodities considerably exceeds in the Pittsburgh district alone the entire output of iron and steel annually produced in Great Britain and her colonies. Pittsburgh makes more steel rails, more plates for the hulls, boilers, and armament of ships, more pressed steel cars and coaches than any other city in the world. During the World War the capacity of her mills and furnaces was taxed to supply the needs of the Allies and later of the government of the United States, and it is said upon excellent authority that 60 per cent of the metal supplies used by the United States came originally in the rough and largely in the finished shape from the Pittsburgh district. Before the output of the great steel-making establishments of Pittsburgh, that of the Krupp works at Essen in its palmiest days sinks into relative insignificance.

Pittsburgh is the seat of the manufacture of aluminum in America and the industry was originally developed here, the process being the result of experimental work by Pittsburgh men, followed by the application of their efforts and capital. Bronze, brassware, copper in various shapes, tin-plate and white lead are extensively manufactured. In short all the industries in which the metals play a part are developed in this great metallurgical centre, more especially so far as the production of raw materials is concerned, although finished product is produced in vast quantities. Recent statistics show that Pittsburgh supplies with their raw material certain great industries in the United States in the following proportions: manufacture of automobiles, 46 per cent; hardware, 45 per cent; agricultural implements, 44 per cent; machinery, 37 per cent.

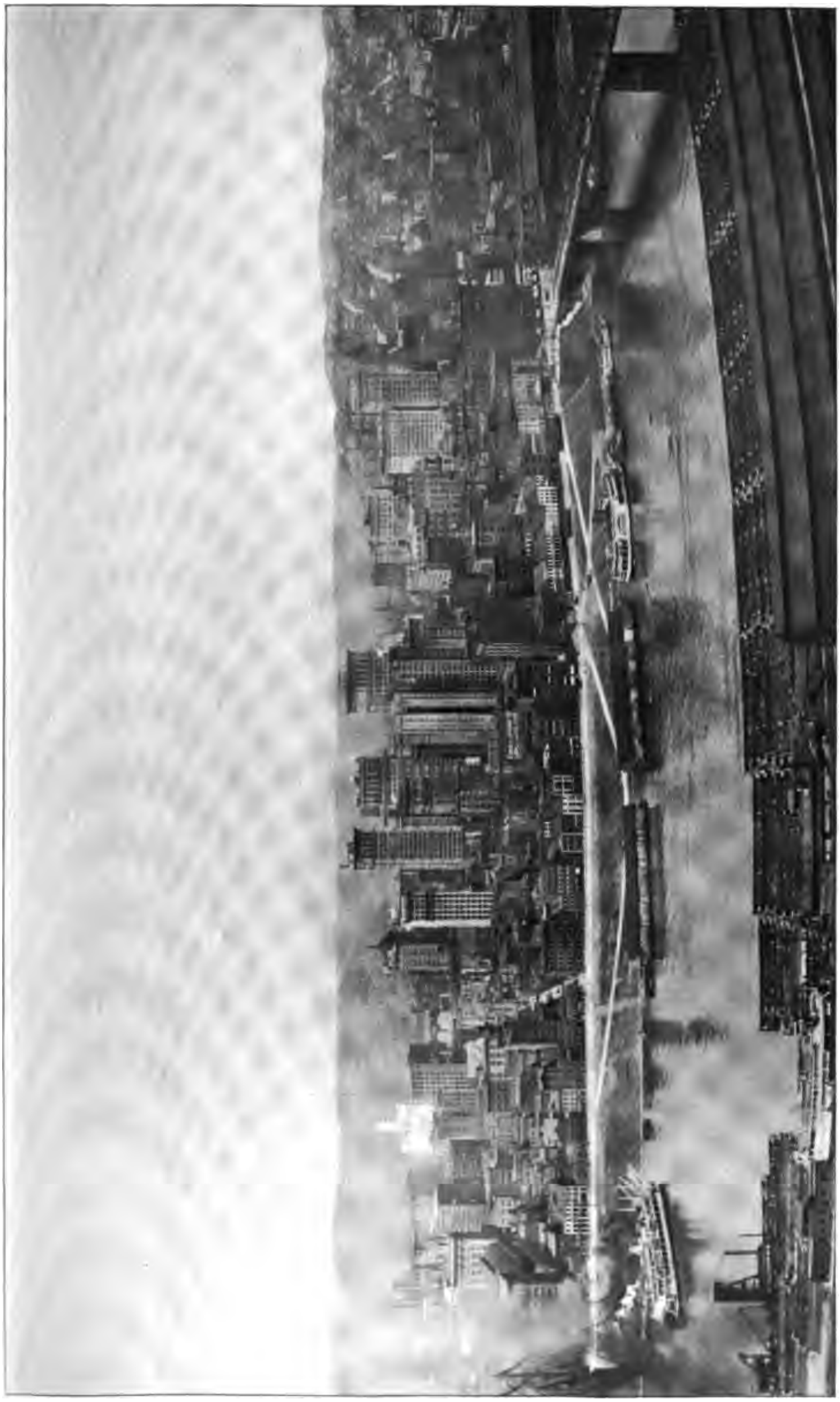
The making of structural steel shapes employed in the building of edifices had its beginning here and it is said that the plans and specifications for a majority of the "sky-scrapers" built in the great cities of America are to be found in the archives of the steel-mills of Pittsburgh.

Pittsburgh leads the world to-day in the production of plate glass, window-glass, pressed table-ware, bottle-ware and lamp chimneys. The finer manufactures in glass are also well represented by establishments which make diffracting prisms used in lighthouses, lenses for opera-glasses, telescopes, range-finders and microscopes. The optical establishment of Dr. J. A. Brashear has a world-wide reputation for the excellence of the lenses turned out. The output of the Pittsburgh Plate Glass Company in 1918 was 31,600,000 square feet and the total production of plate glass in the district in 1918 was nearly 60,000,000 square feet, which if made into one sheet would cover an area of 1,377 acres, or make a pane of plate glass three miles high by one mile wide and the ordinary window-glass made here would, if in one piece, be a pane nearly three times as large. The largest manufactory of corks in the world (corks are the corollary of bottles) is located here and not only makes stoppers for phials and bottles, but everything which can be made from cork, including life-preservers and linoleum. Enameled ware is extensively manufactured and the Standard Sanitary Manufacturing Company is famous for its beautifully perfect wares. Its trade with South America has attained very large proportions and it exports its products to every quarter of the globe. In recent years a great development has taken place in the chemical industries, especially those which are connected with the by-products of the coke industry. The manufacture of coal-tar, ammonia and various derivatives of coal-tar has assumed large proportions. During the European War, Pittsburgh produced an immense quantity of high explosives, which her position fitted her to supply at low rates of cost, and train-loads of trinitrotoluol were continuously shipped from the district.

The packing of meats and the preserving of other food products is an extensive business and employs a large amount of capital and labor. The products of the Heinz Company, which is known to be the largest establishment of its kind in the world, are widely distributed and may be purchased in Argentina, Australia and at the Cape, as well as in Paris, London and Tokio. The manufacture of salt is extensively carried on, the salt water being drawn from artesian wells and the salt obtained by evaporation. The refining of oil and the manufacture of gasoline is a great business, and Pittsburgh was the original centre of the oil-refining industry, which has spread extensively elsewhere. One of the very large and profitable undertakings of Pittsburgh is the manufacture of fire-brick for the lining of furnaces and also of building-brick. Fire-clay and the silicates which are employed in this industry are found near at hand in abundance and the Harbison and Walker Refractories Company is known among smelters all over America for the excellence of its product. The manufactures of machinery, especially electrical machinery of all kinds, has attained a great development. The group of industries, which perpetuate the name of George Westinghouse, Jr., the Westinghouse Air-Brake Works and the Westinghouse Electrical Company are colossal enterprises, the reputation of which is international. Another notable industry is the manufacture of wire in all its forms and its insulation for electrical purposes. The American Wire Works and Pittsburgh Steel Company produce an enormous output of wire and without them the battles in the trenches of Europe might have been different in their result from what the event proved. Barbed wire made in Pittsburgh was strung all along the front in northern France and Belgium during the World War. The development of oil and of gas early led men in Pittsburgh to undertake the manufacture of pipes and tubing. These articles may be made by casting or by forging. Both methods are employed in the community. The National Tube Company, one of the integral factors of the United States Steel Corporation, is the largest single establishment in existence, engaged in manufacturing welded pipes. A number of foundries cast pipes from 8 inches to 10 feet in diameter, to be used as water-pipes and mains. Plumbers' supplies bulk large in the output of Pittsburgh factories. There are over 2,500 manufacturing concerns in the Pittsburgh district with their headquarters and offices in the city, with a capital investment of nearly a billion of dollars, employing a quarter of a million of operatives and executive agents, with a total annual output exceeding twice the capital employed. Among the more colossal industries located here are those which are associated with the names of Andrew Carnegie and his partners, which constitute the backbone of the United States Steel Corporation, the American Iron Works, familiarly known as "Jones and Laughlins," the Westinghouse Electric Company, the Pressed Steel Car Works, the Crucible Steel Company of America, the Pittsburgh Steel Company, the McClintic and Marshall Construction Company (which built the lock-gates on the Panama Canal), the American Bridge Company, the Pittsburgh and the Standard Plate Glass companies (the main works of the latter concern located at Butler, Pa., an hour's ride from Pittsburgh), the National Glass Company, the American Window Glass Company, the Standard Underground Cable Company, the Harbison and Walker Refractories Company, the National Tube Company, the Atlantic Refining Company. There are scores of other concerns which might be mentioned, each with a capital running into the millions, but these are some of the largest at the present time.

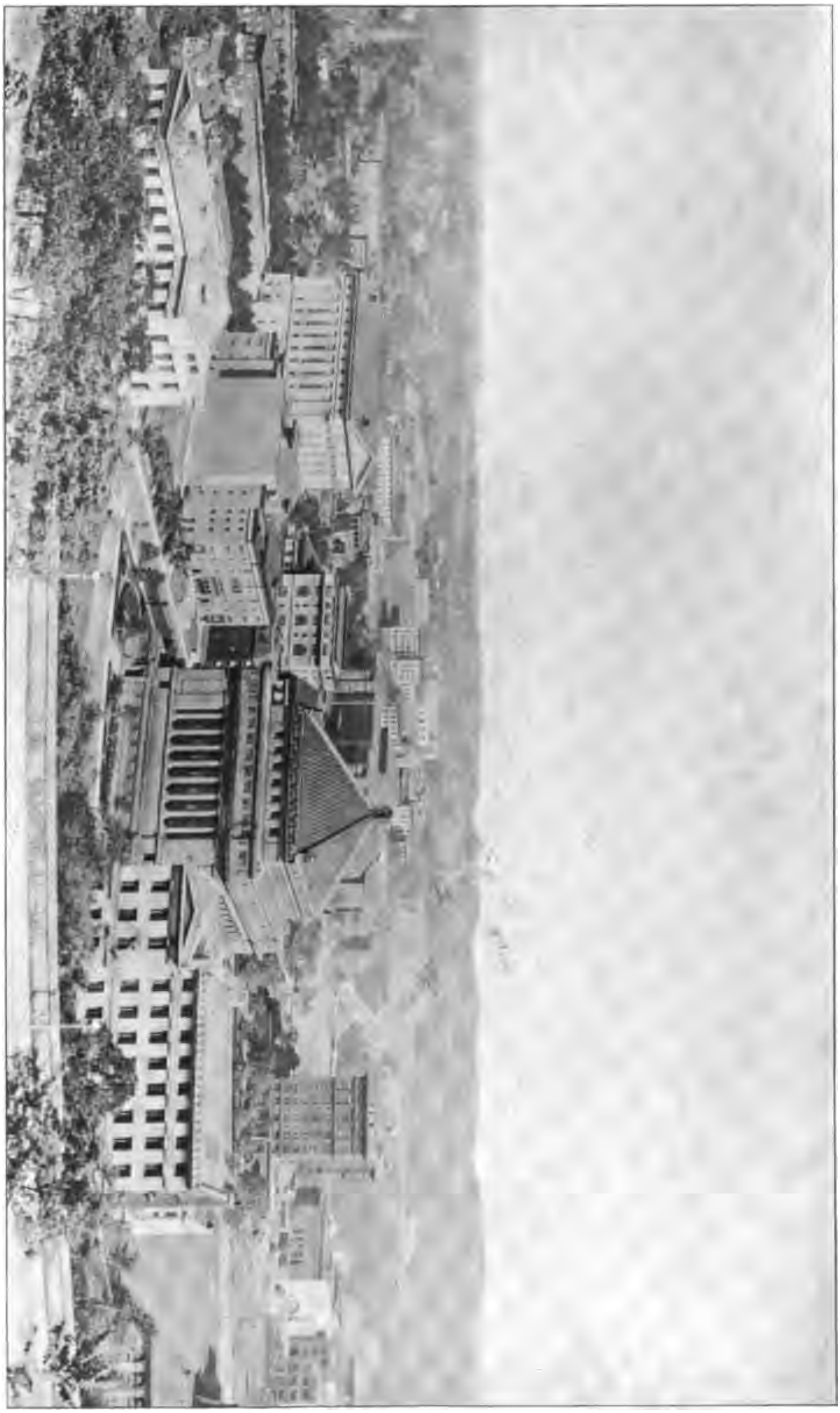
United States Bureau of Mines.—The principal experimental station of the United States Bureau of Mines is located in Pittsburgh in a group of buildings which have been erected

PITTSBURGH



Panoramic view of City from Mount Washington

PITTSBURGH



State Hall Masonic Temple Shriners' Mosque Athletic Club Soldiers' Monument Thaw Hall Shanley Hotel Phipps Conservatory

Carnegie Institute in distance

Civic Center of Pittsburgh

in recent years. Here the work of the Bureau is principally carried on, though the general offices are located in the city of Washington. At the National Safety Meet held in Pittsburgh in 1911, 18,000 coal miners were present. The Bureau has at Bruceton, about 12 miles from Pittsburgh, an experimental mine, where from time to time explosions are artificially produced and rescue apparatus is tested.

Banking Facilities.— For the prosecution of the vast business carried on in Pittsburgh a large capital is required. At the close of business on 31 Dec. 1918, there were 21 national banks, 24 State banks and 31 trust companies, or a total of 76 banking corporations in the Clearing House Association of the city. The accompanying brief table shows in epitome the situation as to these institutions:

CAPITAL STOCK.		
National banks............	$28,350,000	
State banks...............	3,472,700	
Trust companies...........	22,185,400	
		$54,008,100
SURPLUS AND UNDIVIDED PROFITS.		
National banks............	$26,274,344	
State banks...............	8,552,044	
Trust companies...........	63,170,876	
		97,997,264
DEPOSITS.		
National banks............	$388,832,357	
State banks...............	101,784,903	
Trust companies...........	248,403,709	
		739,020,969
Total resources of banks..............		$891,026,333

The Bank of Pittsburgh (N.A.) is the oldest banking institution on this continent west of the Allegheny Mountains, and in 1910 commemorated its centennial. The business transactions of the city represented by the exchanges made in the clearing-house during the year 1918 amounted to the enormous total of $5,761,511,-498.93. Pittsburgh in the amount of her traffic represented by the exchange of the clearing-house stands sixth in rank among the great cities of the country, being outclassed only by New York, Chicago, Boston, Philadelphia and Saint Louis, in the order given, though it frequently happens that the exchanges in the Pittsburgh clearing-house in a given week or month exceed those of Saint Louis. The pay-rolls made out in the banking institutions of the city amounted during the year 1918 to the daily average of $2,750,000, which was due to the war activities of the time, but have receded in 1919. A fair average for the past five years would be $1,960,000 per diem; that is to say the working population in the mills and factories receives a total annual wage of approximately $588,000,000. This does not include payments for clerical, administrative and professional services, but represents simply the return to skilled and unskilled laborers employed in manufacturing, and takes no account of purely commercial or other business.

Chamber of Commerce.— Occupying quarters in a new and commodious building at the corner of Seventh avenue and Smithfield street, the Chamber of Commerce has a membership of 6,000 representing not only all the business firms of the city, but numbering in its ranks many public-spirited professional men, who are interested in the general welfare of the community. The chamber has a very complete organization, enabling it to deal with all manner of questions which may come before it, and to aid strangers and foreigners in securing such information as they may seek in reference to trade and manufactures in the city. It has taken a very active part in securing legislation deemed to be advantageous to the interests of the community and the nation, and many beneficial laws on the statute-books of city, state and nation, found their first advocates here, among which may be mentioned the «Daylight Savings Bill.»

Housing.— Pittsburgh is well-known for the beauty and elegance of its better residential quarters. The eastern extension of Fifth avenue as well as Penn and Highland avenues are lined by palatial homes and such homes are also to be found on Ridge and Irwin avenues on the North Side. Sewickley Heights is adorned with some of the most beautiful and costly residences in America, surrounded by extensive grounds, laid out with great taste. Not only are the homes of the wealthy beautiful, but those also of persons in less affluent circumstances. Pittsburghers, even those of humble means, avoid life in closely compacted quarters, and almost every home, even that of the common laborer, has in front or rear or at the side a small amount of space for shrubbery or garden. There is less squalor and filth per capita in Pittsburgh than in any other great manufacturing city in the world. Intelligent efforts have been consistently made for years by manufacturers and the municipal authorities to combat crowding into close and unsanitary quarters, and any difficulty which has been encountered by them has arisen from the disclination of the unintelligent laborers of foreign origin to adapt themselves to the usages of the country to which they have come. One of the most famous of the millionaires of Pittsburgh undertook a few years ago to build a large number of model homes for workingmen fitted out with all modern conveniences, which were rented at low rates, and then discovered, to his disgust, that the porcelain bathtubs were being used as coal-bins and receptacles for rubbish by the «oppressed» laborers from southern Russia and Hungary who were his tenants, while the coal-bins, which had been provided, were used as sleeping quarters. Pittsburgh has few «slums,» and nothing which may be compared with the «East Side» of New York, the back streets of Buenos Aires or the White Chapel district in London, unless it be the hill district near the centre of the city familiarly known as «Haiti,» which has in recent years become thronged with negroes and poor Italians.

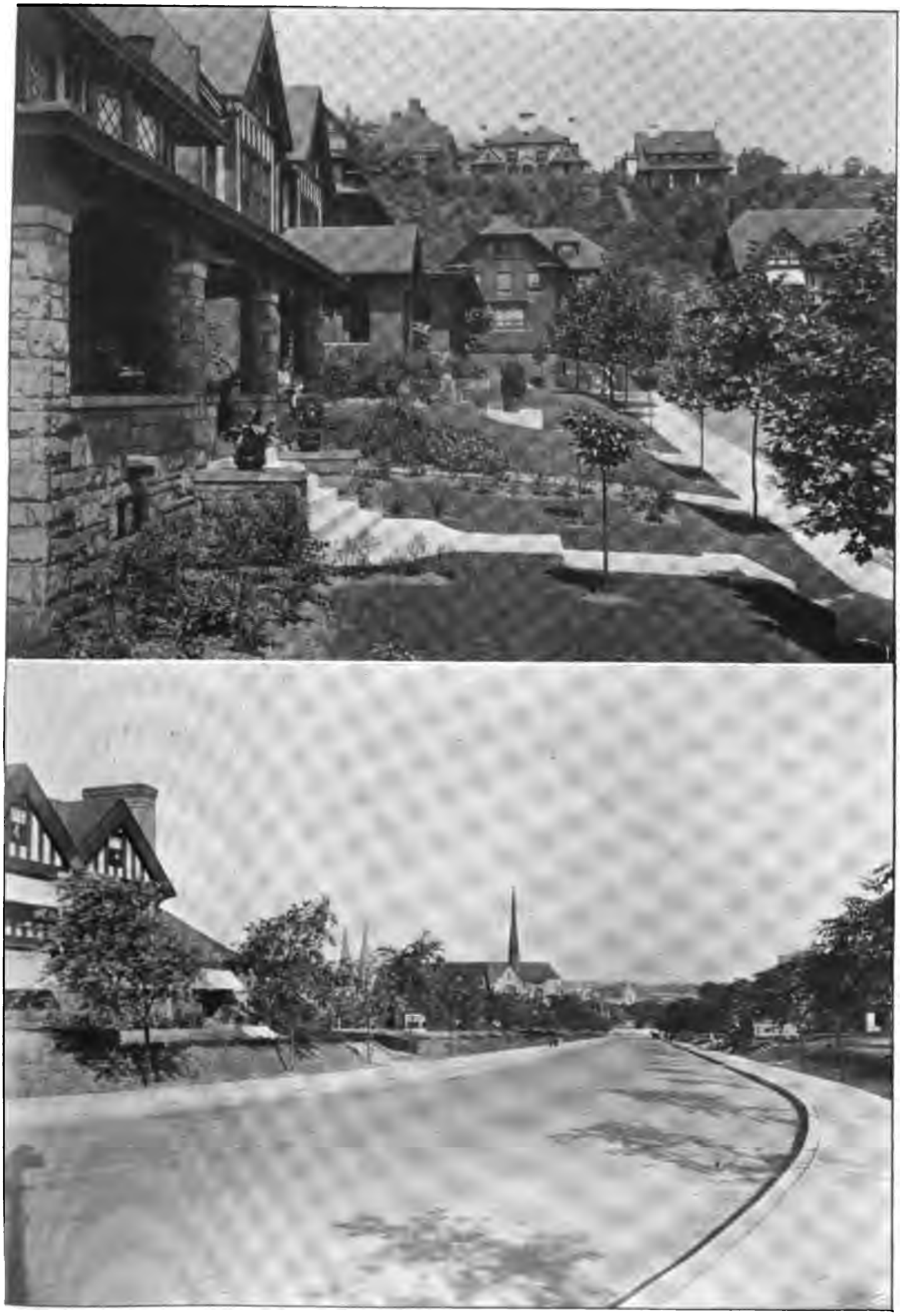
Parks.— The city possesses an extensive system of 26 parks, having an aggregate area of 1,320 acres. Schenley Park, the gift to Pittsburgh of the late Mrs. Mary E. Schenley, contains 422 acres; Highland Park in the extreme northeastern section of the city has 366.6 acres; Riverside Park includes 240 acres, and the Allegheny parks in the heart of the North Side, formerly the Allegheny «Commons,» cover 88 acres. All of the parks have been carefully improved and planted with the advice of the most reputable landscape gardeners in America, and are a joy to the people. Many of them are adorned near their entrance by beautiful buildings and contain groups of statuary. In Highland Park which commands a wide view up the

Allegheny Valley to the north are the Zoological Gardens with fine buildings erected by the late C. L. Magee, and here is the statue of Stephen C. Foster, one of the most noted composers of ballads in America, who was born, lived and died in Pittsburgh, and whose "Old Folks at Home" and "Old Black Joe" are known the world over. At the entrance of Schenley Park are the buildings of the Carnegie Institute and Library, and monuments commemorating Mrs. Mary E. Schenley, the donor of the park, the late E. M. Bigelow, and the late Christopher Magee, public-spirited citizens. Here too is the Phipps Conservatory, rivaling in size the biggest conservatories at Kew Gardens, London. In the Allegheny parks are many monuments and another conservatory, likewise built by Mr. Henry Phipps. At the entrance of Riverview Park is the Allegheny Observatory. Recreation grounds and bathing pools under municipal control are provided abundantly and it is said that Pittsburgh per capita surpasses all other American cities in its use of bathing facilities. This is perhaps due to the grimy work in which a large part of the laboring classes are daily engaged and which leads to a desire for frequent ablutions.

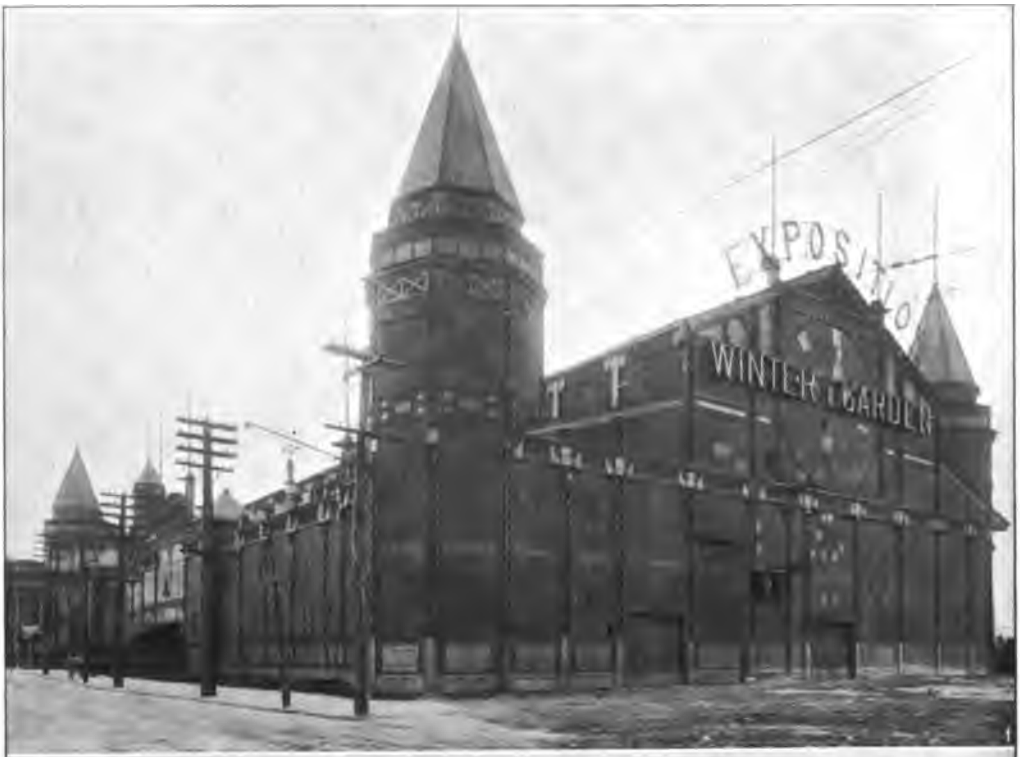
Water Supply and Sanitation.— Pittsburgh was one of the first cities in America to adopt on a large scale the method of slow filtration through sand for the purification of its water supplies. The water is drawn from the Allegheny River above the city limits, is filtered and the effluent pumped across the river to the Brilliant Pumping Station where it is thrown up to higher levels, or is pumped to the great reservoir on the north side which supplies that section of the city. There are three major and two secondary reservoirs, the largest being on the north side, covering 17 acres, at an elevation of 275 feet, and having a capacity of 151,000,000 gallons. The two Highland reservoirs in Highland Park, No. 1 having an elevation of 363 feet, and No. 2 having an elevation of 276 feet, which is cross-connected with the north side reservoir, have a combined area of 38.8 acres and a combined capacity of 242,000,000 gallons. The Herron Hill reservoir, having an elevation of 559 feet and an area of two acres, has a capacity of 12,000,000 gallons, and the Bedford Avenue basin of an elevation of 398 feet has an area of 1.1 acres and a capacity of 2,800,000 gallons. Besides these greater reservoirs there are many tanks at high elevations on the hills with capacities suited to the localities which they supply. All are filled by pumping engines, the greatest of which are located at Aspinwall and at Brilliant on the Allegheny. There were, in 1918, 945 miles of pipe varying from 4 to 66 inches in diameter, with 15,386 control valves and 6,996 fireplugs. The city daily consumes 110,000,000 gallons of water, exclusive of the amounts used in the larger manufacturing plants which pump their water directly from the rivers. The system of water-supply has cost the city $33,000,000, and could not at present be replaced for twice that sum.

Pittsburgh has 669.5 miles of sewers, ranging in size from 8 to 144 inches in diameter. The sewering is carried on by a number of distinct systems, draining certain limited watersheds defined by the topography. The trunk sewers recently constructed are plain concrete, vitrified brick being used as an invert lining. Owing to the prevailing steep slopes the rate of run-off is large, as it is quickly concentrated. The sewage enters the river below Pittsburgh. The matter of erecting a plant for the concentration and treatment of the sewage was carefully investigated some years ago, the report being adverse, the cost of installing a plant for this purpose being found to be prohibitive, and because the existing conditions are such from a sanitary standpoint as not to justify the undertaking. It is an interesting fact that the water of the Monongahela River, being contaminated by the drainage from the coal-mines along its banks, and receiving acid discharges from the numerous manufacturing establishments throughout its lower course, is highly acid in its reaction and very germicidal, so that the acid contamination serves to counteract the bacterial contamination. So strongly acid is the water below Pittsburgh that in the upper reaches of the Ohio for miles below the city all aquatic life, both animal and vegetable, has been practically destroyed. Both the aquatic flora and fauna of the upper Ohio are now extinct.

Extensive provision has been made for the disposal of garbage and rubbish. The American Reduction Company has a contract for peninsular Pittsburgh, and the rest of the city is served by reduction plants situated beyond the city limits and reached by rail. The garbage is treated for the extraction of the grease; the residue is used as the basis for a fertilizer; the rubbish after all portions of value have been salvaged, and the paper for rags baled, is incinerated. The garbage collected during the year ending 31 Jan. 1916 amounted to 93,901 tons, and the rubbish to 50,956 tons. These totals since that date have been increased, but the latest statistics are not available. Practically no collection of ashes is made in the city, natural gas, which produces no ashes, being the prevalent domestic fuel, and the manufacturing establishments dispose of their ashes and cinders by fillage and haulage. Furnace-slag is now very largely utilized in the manufacture of cement, and instead of forming unsightly banks about the furnaces, is a source of profit and disappears in commerce. The fact that natural gas is the prevalent fuel in Pittsburgh, and that it is used in stoves and furnaces which do not as a rule admit of the use of other fuel, accounts for the high per capita amount of rubbish annually removed, which is in other cities burned in the home. The sanitary conditions in the city are upon the whole very good and compare favorably with those of other cities of the same size in the United States. Prior to 1905 the community had an unenviable reputation on account of the prevalence of typhoid fever, but to-day, as the result of the installation of its new and splendid filtration plant, it has lost that evil reputation, and instead of having the highest mortality from this disease, it has the lowest among American cities. The water supplied to the inhabitants of the city throughout the year is not only clear and sparkling, but potable and sanitary. As Pittsburgh has successfully combatted typhoid fever, she is also, with a great measure of success, combatting



Scenes in Residential Section, Schenley District



1 Exposition Winter Garden

2 Larimer Avenue Bridge over Washington Boulevard

other prevalent diseases, and through an efficient bureau of health and sanitation, has waged war against tuberculosis, and all other infectious diseases. The death rate in Pittsburgh is much less than that in some of the other large cities of the United States, though pneumonia, as in all other cities, seems to be on the increase for reasons which have thus far escaped the scrutiny of the medical profession. Malaria is unknown except through imported cases. This is due to the fact that there are no marshy tracts any where in the region, and the waters for half a century have been treated with coal oil from seepage or waste from the wells. *Anopheles,* the malarial mosquito, does not appear to exist in western Pennsylvania.

Universities, Colleges, etc.— The University of Pittsburgh is the oldest institution of learning on the continent west of the Allegheny Mountains, north of the Ohio river. Chartered in 1787 as the Pittsburgh Academy, it was rechartered in 1819 as the Western University of Pennsylvania, the intention of the legislature being that it should fulfill for the western half of the State the functions performed by the University of Pennsylvania in Philadelphia. It still operates under the charter of 1819, but the name was changed in 1908 to the University of Pittsburgh. It is absolutely undenominational, and is recognized as an integral part of the educational system of the Commonwealth, the governor being always a member of the board of trustees, and the support of the university being to a considerable extent provided from the treasury of the State. In 1917 the university had an enrolment of 4,250 students and a faculty composed of 441 persons, the chief executive officer being the chancellor. The number of students was diminished as the result of the late war, but recent reports show a rapid recovery. The service rendered by the university during this war is worthy of mention. Over 4,000 of the alumni and undergraduates entered the army or were engaged in technical duties connected with its maintenance, or the relief of the wounded. Over 70 of these men laid down their lives. One of the base hospitals in France was served by the medical faculty, with its dean at the head of the organization, the original equipment having been provided at large cost by Mrs. Henry E. Collins, a granddaughter of the late William Thaw, whose generous spirit she has inherited. The organization of the university includes 16 different schools, of which the College of Arts and Letters is the largest, having over 600 students. The School of Mines, partly supported by the State, the School of Education, the School of Law, the School of Medicine, the School of Dental Surgery the latter said to be one of the very best in America, the Mellon Institute, and the Allegheny Observatory, are some of the most famous institutions entering into the complex life of the great institution. The Allegheny Observatory, splendidly equipped with instruments, and with considerable endowment, has a world-wide reputation through the researches carried on here by Prof. Samuel P. Langley in the domain of solar physics, and later in aeronautics. Here were laid the foundations of that science which has given to man in these later days the dominion of the air. The observatory is also famous for the classic researches of the late Prof. James E. Keeler upon the nebulæ, which, continued by him at Lick Observatory, have tended to confirm in a remarkable manner the theories of La-Place. The Mellon Institute is a unique institution, owing its origin to the genius of the late Prof. Robert Kennedy Duncan and the splendid generosity of Mr. A. W. Mellon and his brother, Mr. R. B. Mellon, two of the foremost citizens of Pittsburgh. Great and important discoveries in chemistry and the industrial arts are being constantly made here, and there were 39 fellowships in research in operation in 1918. The campus of the university comprises 43 acres in the «civic centre» in close proximity to that great group of noble institutions which during the past decade have found their location here, and which is without parallel in any other city of the Union. Duquesne University is a Roman Catholic institution, originally established by *les Frères du Saint Esprit,* and until quite recently known as the College of the Holy Ghost, under which name it was carried on from 1878 until quite recently. It has some hundreds of students, and recently has announced a course in law. It has a campus and a large building on the top of Boyd's Hill near the heart of the city. The Pennsylvania College for Women is undenominational, but enjoys the special patronage of Presbyterians. It was established about 50 years ago and occupies a beautiful site near Fifth avenue on Woodland road in the residential part of the city. It has good buildings, among which may be mentioned Dilworth Hall, the gift of the late Joseph Dilworth, a prominent manufacturer and merchant of a former generation. There are 250 students in attendance.

The Carnegie Institute of Technology, a department of the Carnegie Institute, and the last to be created by the founder of that complex of institutions in Pittsburgh, which bears his name, has recently grown to great proportions through his lavish gifts. It occupies a tract of about 35 acres adjoining Schenley Park, purchased by the city of Pittsburgh for its use. Here have been erected numerous buildings, splendidly equipped for their purposes. Originally intended by Mr. Carnegie to be a «trade-school» of advanced grade for the poorer and less fortunate young people of Pittsburgh, it has in recent years essayed a more ambitious rôle, and has established courses in the various branches of engineering, in which it confers degrees. A school of the arts in which courses are given in architecture, sculpture, modelling, painting and the drama has been created. The small theatre in this school is a very perfect example of what a theatre should be. There are about 3,500 students in attendance from all over the United States, but principally from Pennsylvania, attracted by the advantages furnished at a merely nominal cost. Mr. Carnegie's original gift to this school has been from time to time increased, until it now totals for buildings and endowment the sum of over $15,000,000.

This account of the schools of higher learning in the city would be incomplete without reference to the three theological seminaries, all located in the portion of the city known as «The North-side.» The Western Theological Seminary, situated on Ridge avenue, was founded about a century ago by the Presbyterian Church and has sent out over 2,000 graduates, many of whom have held distinguished positions in the Church and as educators in the colleges and universities of America. The buildings and endowment of the seminary represent an aggregate investment of about $1,500,000. The Theological Seminary of the United Presbyterian Church and that of the Reformed Presbyterian Church are both located on North avenue in close proximity to each other and serve in part to meet the requirements of these two denominations for a trained clergy. Both are well-known "Schools of the prophets," the alumni of which have reflected honor upon them.

Public Schools, etc.— The public schools of Pittsburgh, partly supported by the municipality and partly by the State, are thoroughly organized and well administered under the general control of a board of education appointed according to law by the judges of Allegheny County and selected because of their known fitness for their duties. The school property owned by the city has cost $21,034,221. It consists of 129 buildings with grounds averaging nine acres to each building. There are 96,000 pupils in attendance, 10,077 of whom in 1918 were in the high schools. There were 2,616 teachers employed in the same year. The buildings, many of which have been erected in quite recent years, are notably well adapted to their use, one of the best examples being the Schenley High School on Bigelow boulevard. The Roman Catholic parish schools number 65, with an enrolment of over 30,000 pupils and 632 teachers. There are nine well-established private commercial schools, enrolling 3,600 pupils, and seven preparatory schools with 1,400 scholars. Through the generosity of Mr. Henry C. Frick there has been established a fund of $500,000, the interest of which is annually to be expended in sending the teachers of the public schools, who may be selected for their special fitness, to summer schools, where they may at once be refreshed and further qualified for their duties. A board of trustees chosen by Mr. Frick, and having self-perpetuating powers, administers this fund.

The Carnegie Institute and Library.— This complex of institutions holds an unique position. An English writer has recently denominated it as "the world's greatest and most splendid storehouse of knowledge." Mr. Carnegie's original offer to found a library was made in 1881, but it was not until 1887 that the gift was made possible by enabling legislation. The first offer had been to give $250,000 for this purpose, but in 1887 the amount was increased to $1,000,000, with the stipulation that the main building should afford accommodations for a museum and a gallery of art, and that branch libraries should be provided, and that the city should obligate itself to provide for the maintenance of the library and its branches. For the maintenance of the museum and the art gallery Mr. Carnegie provided $1,000,000, placing this sum in the care of the trustees of the library and of 18 others, associated with them, 36 trustees in all, who constitute the controlling body. Of these trustees nine directly represent the government of the municipality. Mr. Carnegie from time to time increased the building and the endowments and later added the technical schools, as a third department, under the same general control. The original main building of the library and institute was greatly enlarged at Mr. Carnegie's suggestion, he agreeing to defray the cost, and the building was rededicated in 1907 with appropriate ceremonies in the presence of representatives of the governments and leading institutions of learning both of America and Europe. In all the gifts of Mr. Carnegie to this complex of institutions amount to a total of approximately $30,000,000.

The main building, housing the central library, the hall of music, the museum and the art galleries, is three stories in height and covers approximately six acres. Its exterior is of light gray sandstone in a modification of the Italian Renaissance. The entrances are flanked by statues of Shakespeare, Bach, Galileo and Michelangelo. The interior, which is resplendent with the finest marbles, provides a great hall of music, where throughout the year, except in the heated summer months, free organ recitals are given every Saturday evening and Sunday afternoon. The department of fine arts controls the galleries of architecture, sculpture, paintings, and engravings. These galleries are large and stately and contain already notable collections of art in all its departments, and especially a representative assemblage of the best works of recent American and European painters. Here is annually held an international exhibit of paintings, to which the artists of the world contribute, the only "Salon" in America.

The museum is a general museum, laying special stress upon the natural sciences and the industrial arts. The staff consists of about 40 persons, a number of whom are engaged in special scientific researches in connection with their other duties. The collections in the possession of the museum, either permanently or as loans, at the present moment have an aggregate value of approximately $2,000,000. The museum possesses one of the largest and most important paleontological collections in the world, including the great collections made in the Western States by the museum itself and the collection of Baron Ernst Bayet of Brussels, purchased for the museum by Mr. Carnegie, representing the extinct faunæ of Europe. The collections of birds contain approximately 80,000 specimens; the mammals are represented by many thousands of specimens, many of them superbly mounted in groups, among which may be mentioned the collection of East African mammals collected by Mr. Childs Frick and parts of the collections made by the late Col. Theodore Roosevelt. One of the largest collections of South American fresh-water fishes is here, and one of the very largest entomological collections in the New World, containing the types and cotypes of many thousands of species. The ethnological collections are large and one of the very best assemblages of Indian basketry and an unrivaled collection of Costa Rican antiquities are specially worthy of mention. The ivories and the timepieces collected by the late H. J. Heinz ornament a room specially set apart for their display, and the exhibit of miniatures, waxes, snuff-boxes, fans and other articles of vertu loaned by Mr. Herbert Dupuy is viewed with endless admiration by visitors.

The library, which occupies the southwestern portion of the great edifice, is provided with a fireproof stack capable of holding 1,000,000 volumes. It already possesses approximately 400,000 books. The facilities for consultation and reference are unequalled. There are eight branch libraries administered from the main library, situated in different residential sections of the city and beautifully housed, and in addition there are a multitude of «exchange-centers» through which readers may obtain and return books without journeying to the main building or the branch libraries to do so. The technical schools, latterly known as the «Carnegie Institute of Technology,» have been outlined under the paragraph dealing with institutions of higher learning.

Libraries.— In addition to the great Carnegie library which has been briefly described in the foregoing account of the Carnegie Institute and Library, there are a number of other libraries of importance in the city. The Allegheny library, which was erected by Mr. Carnegie prior to the establishment of the Carnegie library in Pittsburgh, Allegheny at that time not being a portion of Pittsburgh, cost the donor over $300,000 for its erection and equipment, and is also maintained by the city for the benefit of the residents of the Northside. It possesses a large and useful collection of books. There are important collections of books in the library of the University of Pittsburgh, which has recently been enriched by the great collection of *Americana* made by the late William M. Darlington, Esq., whose daughters have transferred it to the university as a gift in memory of their father. The library of the Allegheny Observatory is very large and rich in works upon astronomy, physics, and mathematics. The libraries of the various theological seminaries are well supplied with books, that of the Western Seminary containing about 40,000 volumes, including one of the most perfect collections of works relating to ecclesiastical music and hymnology in existence, which has recently been acquired.

Scientific Associations, etc.— There are a number of associations in Pittsburgh, some of which have a large membership, devoted to promoting the sciences and the arts. The Engineers Society of Western Pennsylvania is one of the strongest bodies of its kind in the country and has its headquarters in the Union Arcade building. The Art Society of Pittsburgh was established nearly 50 years ago and promotes interest in music, painting and other fine arts. The Academy of Science and Art of Pittsburgh has a membership of over 2,500 and annually provides lectures upon scientific topics in the lecture hall of the Carnegie Museum. The number of such lectures in 1918 exceeded 50. The Associated Artists of Pittsburgh has a membership of about 100 persons who practise painting, sculpture, and architecture. The Authors' Club of Pittsburgh has a membership of over 50. The Pittsburgh branch of the Archeological Institute of America is vigorous and by annual appropriations helps to maintain the classical schools at Rome and Athens founded by the Institute. The Historical Society of Western Pennsylvania occupies a building erected in the «civic centre» in proximity to the buildings of the university.

Social Clubs and Fraternities.— The Pittsburgh Directory in 1918 shows that there are 115 social clubs and fraternities in the city. Some of the largest and better known clubs are the Pittsburgh, the Duquesne, the Union, the Monongahela and the University Club. The Pittsburgh Golf Club, the Allegheny Country Club and the Oakmont Golf Club are beautifully housed and are frequented by lovers of outdoor sport. The annual meet of the American Association of Golfers to decide the national championship in golf took place in 1919 upon the links of the Oakmont Club. The Pittsburgh Athletic Association has its clubhouse in the civic centre on Fifth avenue. The building cost over $1,000,000.

Hotels.— Pittsburgh has numerous hotels, some of them of large size and modern in all their appointments. The Hotel Schenley in the civic centre is in proximity to the university, the Carnegie Institute and the many buildings grouped near the entrance of Schenley Park, and contains 260 rooms. The Fort Pitt and the William Penn, the latter recently opened and having 904 rooms, are fine examples of the best class of hotels. There are many others, and with an abundance of halls, large and small, for meeting places, Pittsburgh in recent years has come to be widely regarded with favor as a «convention city,» and gatherings of from 2,000 to 6,000 delegates frequently assemble here.

Newspapers, etc.— The Pittsburgh *Gazette-Times*, originally established as the Pittsburgh *Gazette* in 1786, is one of the oldest newspapers in America and the first established on the continent west of the Allegheny ridges. There are published in Pittsburgh eight daily papers of large size and 60 other weekly, trade, religious, scientific, and social journals and periodicals. Books bearing Pittsburgh imprints have been issued from as far back as 1789, and while publishing is not one of the leading industries of the place, its aggregate annual volume is not inconsiderable.

Churches.— There are 489 churches and places of religious assemblage in Pittsburgh. Almost every religious denomination is represented in the community, so that the early prediction of Arthur Lee, who visited the spot in 1786 and found «Not a priest of any persuasion, nor church nor chapel,» and who, therefore, declared the people to be «likely to be damned without benefit of clergy,» is certain not to be fulfilled. Pittsburgh is the seat of a Roman Catholic and a Protestant Episcopal bishop, and is the seat of the Board of Missions to the Freedmen of the Southern States of the Presbyterian Church, and of all the ecclesiastical organizations of the United Presbyterian Church in America. The vast influx of people from the south of Europe in recent years has somewhat changed the religious complexion of the place, but originally settled by the Scotch it is still in certain aspects as much a Presbyterian community as Glasgow or Edinburgh. The churches of the major denominations in the city are in number as follows: Baptist, 56; Christian, 12; Congregational, 4; Episcopal, 24; Evangelical (mostly German), 10; Jewish synagogues, 21; Lutheran (all branches), 53; Methodists (all branches), 73; Presbyterians and Reformed, 93; Roman Catholic, 81; miscellaneous, 62. Thirty-three churches are attended and maintained by the colored population, 20 of these being Baptist and 11 Methodist. Many of the church edifices are large and some very beautiful and costly. Saint Paul's Catholic Cathedral, situated at the corner of Fifth avenue and Craig street, is a very large and stately structure in a somewhat inornate Gothic style, imposing by its mass rather than by the perfection of its lines. Calvary Episcopalian Church on Shady avenue, designed by Ralph Adams Cram, is pronounced in Baedeker's 'Guide to the United States' to be «the finest example of Norman Gothic in the New World.» Trinity Church, in the heart of the old city, is a fine edifice, and so also are the First and Third, the Shadyside and the Bellefield Presbyterian churches, and Christ Methodist Episcopal Church. But these are only a few of the really noble church buildings which have been erected in the city, principally in the past three decades.

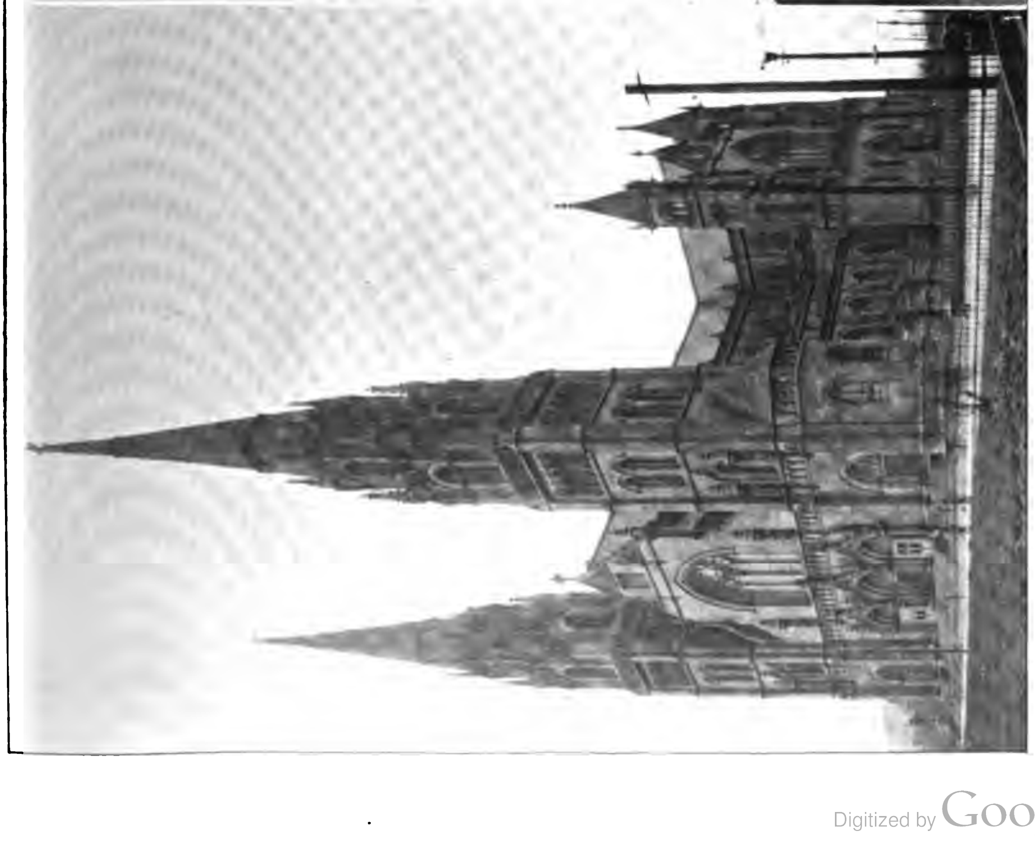
Hospitals, etc.— The city is well supplied with hospitals, some of which are very large, and most of which occupy buildings which are modern. There are 48 hospitals and infirmaries, the largest being the Western Pennsylvania Hospital, the Mercy Hospital, the Elizabeth Steele Magee Memorial Hospital, founded by the late C. L. Magee in memory of his mother, by the donation of about $4,000,000, the Allegheny General Hospital, the Columbia, and the Homœpathic Hospital, but there are many others, nearly as large. There are numerous special hospitals, for the treatment of diseases of special organs, such as the eye and the ear, or for the treatment of special forms of disease, such as tuberculosis, etc. The Pennsylvania Hospital for the Insane at Dixmont, a nearby suburb, is a huge establishment, administered by the trustees of the Western Pennsylvania Hospital. Almost all the hospitals are in receipt of aid from the treasury of the State of Pennsylvania, but depend in the main upon the charity of the citizens.

Charities Other than Hospitals.—There are 250 or more charitable institutions or foundations in the city, other than those which care directly for the sick and wounded, and which are maintained by charitable gifts by the living or with funds which have been bequeathed to them by the dead. One of the unique foundations created by Mr. Andrew Carnegie is The Hero Fund. His gift consisted of $5,000,000, which he entrusted to a body of 21 trustees with the power of self-perpetuation, who were instructed to use the annual interest in caring for those in civil life, who may have made heroic efforts at the risk of their own lives to save the lives of others, or in event of death in the performance of the act, to care for destitute dependents. The operation of the fund is restricted to the United States, Canada and Newfoundland. Since the trustees accepted the trust in 1905 they have had before them over 20,000 cases of alleged heroism, and have made awards in over 1,500 cases. The awards consist in every case of a medal, reinforced by a donation of money for a worthy purpose in all needy cases. The monetary award is made for the purchase of homes, the payment of debts, establishment in business or in the case of the young for education. Pensions are given to widows and orphans. At the present time the fund is paying pensions to 250 widows, and is caring for 226 children, left fatherless; is educating in school and college 46 young people; and providing for 16 other poor people. The fund through wise investments has increased to nearly $8,000,000 and its annual benefactions amount to nearly a quarter of a million of dollars, carefully expended under vigilant supervision in such a way as to benefit and not pauperize the recipients. The Carnegie and United States Steel Pension Fund for the relief of aged and incapacitated employees is administered in offices adjoining those of the Hero Fund, and have at their disposal the interest of $12,000,000. The Western Pennsylvania Institution for the Blind, the Western Pennsylvania Institution for the Deaf and Dumb, are great and well-administered establishments. Scores of others might be named, but to describe them all would be to write a volume. Suffice it to say that in proportion to the number of its inhabitants there is no other city in the country which has shown a more benevolent and altruistic spirit, recognizing the responsibility of those who have to minister to those who may be in need. No call for help ever reached the ears of Pittsburgh which has been allowed to pass unheeded.

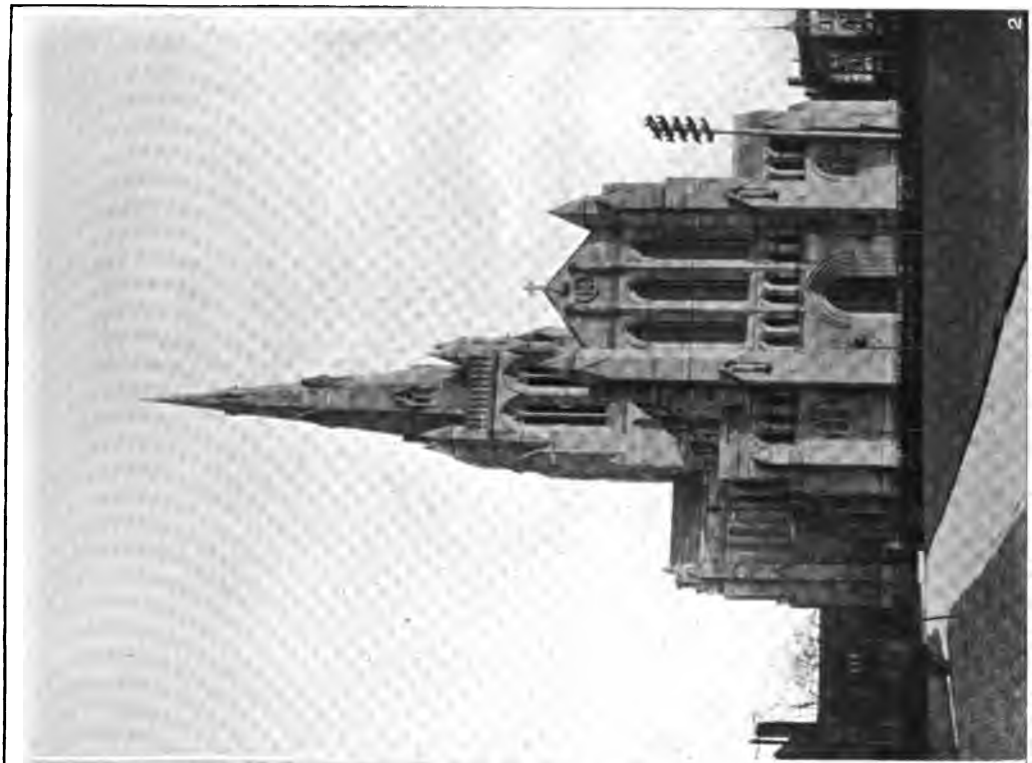
Cemeteries.— The cemeteries of Pittsburgh of which there are 23 are beautifully laid out and abound in noble monuments of those who have lived and died here. The most beautiful and extensive are the Allegheny, the Homewood and the Uniondale cemeteries, the latter on the north side on one of the high hills overlooking the city.

Government.— The city of Pittsburgh is divided into 27 wards. The administration is entrusted to a mayor, elected quadrennially, and to the officers under his authority, known as chiefs of departments, or heads of bureaus. The legislative power, the power of making appropriations and fixing the annual tax-levy is entrusted to a council composed of nine members, elected by the people and receiving annual salaries, judged sufficient to enable them to devote their entire time, if necessary, to the public business. The old system of unpaid representatives, divided into two houses, forming a «Select Council,» corresponding to the Senate, and a «Common Council,» corresponding to the House of Representatives of the nation, was a number of years ago adjudged by the people to be cumbrous, inefficient, and useless, and was discarded, after a number of the so-called «representatives» of the people had been sent to jail for theft, perjury, and other offenses. The method of government by a small body of truly representative citizens, receiving compensation, and obligated to bring to their tasks their best powers, has proved far more satisfactory than the old method of employing a miscellaneous assemblage of irresponsible parties, the majority being «ward-heelers,» taking their orders from self-constituted «bosses.» The general supervision of all financial matters is under the care of the city controller, a very important officer, who acts as «the watch-dog of the treasury.» The revenues of the city, including the balances from the previous year, amounted in the year 1917 to $19,397,035.16; the expenditures were $16,118,606.52. The total assets of the city, as a cor-

PITTSBURGH



1 Saint Paul's Catholic Cathedral



2 Calvary Protestant Episcopal Church

1 Carnegie Institute

2 A Branch Children's Room, Carnegie Library poration, on 31 Dec. 1917, were $43,489,714.98, of which amount $33,199,300 represented the proceeds of the sale of municipal bonds in former times. The net bonded debt of the city at the same date, deducting the amounts in the sinking funds, was $32,737,851.16. The assessed value of taxable property in 1916 was $782,563,920.

The principal departments of administration are that of public safety, having charge of the police, the bureau of fire, etc. The police force is large, well drilled and commanded. There are 61 engine-houses in the municipality, and with an abundant water-supply at command, the Underwriters Association of America has expressed itself as holding that in this respect the city is as well protected as any other in America. The department of public works has charge of the highways, bridges, sewers, waterworks and also of the public buildings and parks. The department of law, at the head of which is the city attorney, attends to all legal matters, including the prosecution of offenders in the courts. There is a considerable body of magistrates, who are under municipal appointment, whose business it is to take cognizance of certain offenses against municipal ordinances. The department of public charities has charge of the various eleemosynary agencies of the municipality, including the homes for the destitute and aged, which have been provided. The bureau of public health is well equipped and manned by scientifically trained officials, provided with abundant laboratory facilities. The city in June 1919 voted for the sale of $20,000,000 of bonds with the proceeds of which to build a new boulevard from the eastern portions into the centre, to be called, «The Boulevard of the Allies,» to construct a subway, with which it is hoped to relieve the congested traffic at the centre, and to make various other improvements which will add to the beauty of the place and promote the comfort of its inhabitants. The seat of the government is in the so-called «City and County Building,» jointly erected by the municipality and the county of Allegheny, and occupied by certain of the officials of both. It is a huge pile, covering the block between Grant and Ross streets, flanked by Fourth avenue and Diamond street, adjoining the Allegheny Courthouse.

Early History.— The valleys of the Ohio and the Mississippi were originally claimed by the French in virtue of the explorations and discoveries of La Salle in 1669. Virginia laid claim to the valley of the Ohio in virtue of her charters; and in 1748 the Ohio Company was formed to exploit and take possession of the region. In 1749 a French expedition under Celeron was dispatched to formally annex the Ohio Valley to the French crown. This expedition was followed by the French in the spring of 1753 by a small army of occupation, which did not advance further than the present site of the town of Venango, Pa., where it went into winter quarters. In the fall of 1753 Governor Dinwiddie of Virginia sent George Washington to warn the French against further intrusion and in the spring of 1754 a force of Virginians was sent to build a fort on the site of the present city of Pittsburgh. While engaged in this work the small body of troops, commanded by Capt. William Trent and Ensign Edward Ward, was confronted by an overwhelming force of French and Indians coming from the north. The Virginians withdrew. The first armed encounter between the French and the Virginians took place on 27 May 1754, when Washington defeated and captured a body of French troops under Jumonville near the mouth of Redstone Creek. This engagement was followed by the battle of Fort Necessity, where the Virginians were defeated, but allowed to withdraw with the honors of war. In 1755 an attempt to retake the spot was made under the command of Major-General Braddock. It resulted in the terrible defeat at Braddock's Field on 9 June. The French, who in the meanwhile had built Fort Duquesne, held the region until 25 Nov. 1758, when they fled before the advance of General Forbes, leading an army of 10,000 British and Colonial troops. In the dusk of the evening of that day Colonel Armstrong planted the flag of Great Britain over the smouldering ruins of Fort Duquesne, which the French had fired as they abandoned it, and, at the suggestion of George Washington, Forbes called the place Pittsburgh. «It is,» says Bancroft, «the most enduring monument to William Pitt. America raised to his name statues that have been wrongfully broken and granite piles of which not one stone remains upon another; but long as the Monongahela and the Allegheny shall flow to form the Ohio, long as the English tongue shall be the language of freedom in the boundless valley which their waters traverse, his name shall stand inscribed upon the gateway of the west.» The English occupation continued until the outbreak of the American Revolution and was made memorable by the series of engagements which took place on the spot, or near by, during the period of Pontiac's Conspiracy and the events of the French and Indian War. The only remnant of the extensive fortifications erected by the British is the «Old Block-house,» which was a redoubt built by General Bouquet in 1763 and which still stands, being the property of the Pittsburgh Chapter of the Daughters of the American Revolution, presented to them by the late Mrs. Mary E. Schenley.

A town was laid out about Fort Pitt in 1764 under the authority of Col. John Campbell and this plot, which was incorporated in subsequent surveys, is commonly known as «the old military plan.» The «Manor of Pittsburgh,» reserved to the Penns by acts of assembly in 1779, had been originally surveyed in 1769, and was resurveyed in 1783 by George Woods. In the following year a portion of it was plotted as the site of the town of Pittsburgh. On 22 April 1794, the place was incorporated as a borough and in 1816 it was reincorporated as a city. Several acts of reincorporation have been passed by the legislature of Pennsylvania since then and the original limits have been gradually enlarged by the annexation of contiguous territory.

The Spirit of Pittsburgh.— Pittsburgh enjoys a well-deserved reputation for the generosity and civic pride of its citizenship. An illustration of its devotion to the Commonwealth was furnished by its loyal response to the call of the country for funds with which to prosecute the World War and provide for the various works of relief incident thereto. The per capita contributions of Pittsburgh to the different Liberty Loans, to the support of the Red Cross and other agencies, exceeded that of every other city in the Union. Its total subscription to the Liberty Loans amonnted to $625,429,600, exceeded only by that of the Wall Street district in New York and representing a total oversubscription of $118,708,850. To those who only know Pittsburgh as they may have caught a glimpse of her fires and seen the smoke, which on still and foggy days fills the valleys about her, as they have been whirled into and out of her portals on trains, she may indeed seem forbidding; but those who have traversed her avenues at leisure, who have visited her great establishments, who have studied the splendid institutions which reflect her love of science, learning, and art, and above all who have experienced the warmth of the open hospitality which clings to her with the traditions of the earlier days, grow to love and admire her. She has learned the secret of transmitting material prosperity into «the things of the spirit.» Though still at times «swart with the smoke of her forges» she is known today as one of the great scientific, artistic, and educational centres of the New World. She has justified her motto «Pittsburgh Promotes Progress,» as she has justified her title «The Workshop of the World.» The citizens of Pittsburgh who have risen to distinction in various walks of life are legion and her glory is not so much that she makes steel as that she makes men. From her distinguished bar she has given to the Supreme Court of the United States a number of judges. To the halls of national legislation she has sent many senators. She has been represented in the Cabinet by many of her illustrious sons and repeatedly has provided governors for the Commonwealth of Pennsylvania. To the long list of the world's most eminent inventors, financiers, philanthopists, artists, and men of science she has added a striking array of names with which the student of her history is familiar. She is proud of her Stephen C. Foster, whose songs are sung the world over; of her Keeler, who wrote his name on the stars; of her Langley, who paved the way for man's dominion of the air; of her Stanton, man of iron, who, when others wavered or were faint, stood like a wall of adamant amidst the conflict, of the Civil War; of her Westinghouse, prince of inventors; and of her Carnegie, king of philanthropists. She rejoices in her sons, a mighty army of them, the story of whose deeds would fill volumes, who in many callings and in many lands have done honor to the great gray city, which sits as «The Mother of Prosperity» at the fountain-head of the beautiful Ohio.

W. J. Holland,
Director Carnegie Museum, Pittsburgh.

PITTSBURGH, The University of. Formerly the Western University of Pennsylvania, coeducational institution of higher education, located at Pittsburgh, Pa. The first charter was granted in 1787 under the name of the Pittsburgh Academy, the second oldest institution of learning west of the Appalachian Mountains. The constitution of Pennsylvania adopted in 1790 provided for one or more institutions of learning and under this provision the existing institutions in Philadelphia were rechartered in 1791 as the University of Pennsylvania and in order to provide the same educational opportunities in the western part of the State the Pittsburgh Academy was in 1819 rechartered as the Western University of Pennsylvania. The University has continued to operate under this second charter until the present time, changing its name in 1908 to the University of Pittsburgh. While the University offered courses in engineering as early as 1845, and while it operated a law school from 1840 to 1849, and again in later years, yet until 1892 the institution confined itself chiefly to the work of the ordinary college. Between 1892 and 1896 the University established permanently the school of law and in affiliated relations schools of medicine, dentistry and pharmacy, all of which have now become integral parts of the University, except the school of pharmacy. The University now includes the following schools and departments: The college, school of economics, school of education, school of engineering, school of mines, school of chemistry, Mellon Institute, graduate school, the observatory, school of medicine, school of law, school of dentistry, school of pharmacy, department of university extension, department of physical education, department of health, department of military science and tactics. The University offers the usual degrees, both bachelor and graduate. It has been since 1895 open to women in all its schools and departments, exactly as to men. The Allegheny Observatory was founded in 1859 and became a part of the university in 1867. It was in this department that Professor Langley did his great work and under the benevolent assistance of William Thaw solved the problem of aviation. The requirements for admission in the schools of law and medicine are the usual high school course and two years of college work. The University of Pittsburgh along with the University of Pennsylvania and State College receive biennial appropriations from the Commonwealth. The amount for the biennium 1917–19 is $750,000. At the beginning of the academic year 1917–18 military training was made compulsory in the University of Pittsburgh and was successfully conducted until 1 February, at which time the Reserve Officers' Training Corps was established. In the late summer of 1918 the Reserve Officers' Training Corps was suspended during the period of the war in order that the government might establish in the University the Students' Army Training Corps. This training corps is divided into two sections: (a) the collegiate section, in which courses are offered to boys 18 years old and upward who desire training along lines of especial value to the government. There are about 2,000 enrolled in this section; (b) the vocational section, in which are offered courses along the lines of gas engine, motor mechanics, etc. There are 1,700 enrolled in this section. The total enrolment in the Students' Army Training Corps and in the regular work of the University in 1918–19 was about 4,500. The total number in the faculty, including assistants and demonstrators, in 1919 was 219.

PITTSBURGH LANDING, Battle of. A battle of the Civil War fought 6 and 7 April 1862 at Pittsburgh Landing in Tennessee, on the west bank of the Tennessee River, about 20 miles north of Corinth, Miss. See Shiloh, Battle of.

PITTSFIELD, pĭts'fēld, Mass., city, county-seat of Berkshire County, on the New York, New Haven and Hartford and the Boston and Albany railroads, about 50 miles northwest of Springfield. It was settled in 1743, incorporated as a town in 1761 and chartered as a city in 1891. It was called at first Boston Plantation and Poontoosuck, but the name was changed to Pittsfield when it was incorporated. Within the present corporate limits are several small villages. The city is noted as the centre of a residential section among the Berkshire Hills; but it has considerable manufacturing; the chief industrial establishments are foundry and machine shops, electrical machinery and supply works, a silk mill, cotton and woolen mills, paper mills, fine stationery, men and boys' clothing. The principal public buildings are the Berkshire Athenæum (cost $100,000), the Crane Art Museum, the courthouse, built of white marble at a cost of $400,000, the Berkshire Life Insurance building, the Berkshire County Savings Bank and the County Home for Aged Women, Agricultural National Bank building, City Savings Bank building. The educational institutions are the high school, academic high school, commercial high school, about 25 grammar schools, Miss Hall's private school for girls, one business college, Saint Joseph's Academy, public and parish elementary schools, the Henry W. Bishop Training School for Nurses, the Public Library containing about 40,000 volumes and connected with the Berkshire Athenæum. There are five public parks, in one of which is a statue, «The Color Bearer.» The government, administered under a revised charter of 1895, provides for a mayor, who holds office one year, and a council. The mayor appoints the license commissioners and the council elects several of the administrative officials. The school committee is chosen at the popular election. The city owns and operates the waterworks. Pop. 39,301. Consult Smith, 'History of Pittsfield'; Mullany, 'History of Berkshire Hills.'

PITTSFIELD, Me., town in Somerset County, on the Sebasticook River and the Maine Central Railroad, 20 miles northeast of Waterville. The Maine Central Institute is located here; there are also a public library, creamery, woolen mills, packing-houses, lumber yards, etc. Cheap power is furnished by the Sebasticook. Pop. 2,891.

PITTSTON, pĭts'ton, Pa., city in Luzerne County, is situated in the historical Wyoming Valley, along the Susquehanna River, nine miles northwest of Wilkes-Barre, the county-seat. Its railroad facilities consist of the Lehigh Valley main line, Delaware, Lackawanna and Western, Delaware and Hudson, Central Railroad of New Jersey, Erie and two interurban lines, connecting with Wilkes-Barre and Scranton. Pittston is an industrial centre of considerable importance. It was settled in 1770, laid out in 1768, incorporated as a borough in 1853 and in 1894 was chartered a city. It was named in honor of William Pitt, when it was first laid out, but for some years it was called Pittston Ferry. It is in the midst of the Wyoming anthracite region and its industries are connected with the mining and shipping of coal. In the vicinity are deposits of fire clay. The chief manufacturing establishments are flour and lumber mills, knitting mills, foundries, machine shops, brick-works, stove and engine-works, breweries, ladies' underwear factory, car shops, tape mill and steel range works. Its many and various industries and facilities for handling and marketing products, cheapness of fuel as well as electricity which may be used for power purposes, make it an ideal place for the investor, the manufacturer, the laborer and the home-builder. The principal educational institutions are the public and parochial schools. It has one hospital which was opened in 1893. There are four banks in the city with a combined capital of $700,000. The population of the city is about 20,000, with a population of about 60,000 residing within two and one-half miles of the city post office.

PITUITARY BODY or **GLAND** (*Hypophysis cerebri*), a small oval, reddish-gray, vascular mass lodged in a depression (pituitary fossa or cella turcica) of the sphenoid bone, and connected with the brain by a pedicle. It consists of two lobes. Its function is complex since each part has a very profound influence in the growth of the body. The growth of the bony skeleton is under the influence of the pituitary. Hyperpituitary states lead to grantism, to acromegaly, and to various anomalies of bony structure. Diminished activity, hypopituitarism leads to obesity, various bony undergrowths and anomalies and a number of mental defects. Consult Cushing, Harvey, 'The Pituitary Body and its Disorders' (Philadelphia 1912).

PITYRIASIS, an affection of the skin (*pityriasis simplex*), characterized by a scurfiness of the epidermis with numerous branny scales. It is also a symptom of various skin diseases attended by accumulations upon the surface of the body of oily, waxy or bran-like scales. *Pityriasis capitis* (dandruff), beginning as a mild affection, may become a part of *dermatitis seborrhoica*, an inflammation of the derma of the scalp; lichen piliaris (*pityriasis rosea*) is a hypertrophic disease with conical elevations of sebaceous material and epithelial cells about the orifices of hair-follicles; *pityriasis rubra* is an inflammatory disease of the entire skin with abundant thin white scales. The favorite seats of pityriasis are the scalp, face, back, chest, umbilicus and the genital organs, but it may involve the whole body. Though usually a mild affection, it may be severe and last for months. In many cases there is little inflammation, the skin being pale and either dry or greasy. Pityriasis occurs especially in anæmic and chlorotic individuals, and is often increased by care, anxiety or dissipation. Treatment calls for tonics, attention to hygienic measures and the application locally of fatty substances, especially stimulating ointments. In pityriasis of the face exposure to cold winds is often irritating; therefore, before going into the open air apply a soothing lotion. Consult Kaposi, 'Pathology and Treatment of Diseases of the Skin' (1895) and Pusey, William Allen (in 'Reference Handbook of the Medical Sciences,' Vol. VII, New York 1916).

PITZER, Alexander White, American clergyman: b. Salem, Va., 14 Sept. 1834. He was educated at the Virginia Collegiate Institute

(Roanoke College) and at Hampden-Sidney College. After studying theology at the Union Theological Seminary, and at Danville, Ky., he began preaching at Leavenworth, Kan., in 1857. From 1851-58 he was pastor of the First Church there, when he returned to Virginia and served as missionary to the Confederate armies. Subsequently he held pastorates at Sparta and Mount Zion, Ga., Cave Spring and Liberty, Va., until 1861, when he undertook evangelistic work at Washington, D. C. Here he organized the Central Church in 1868, of which he was pastor. He is a supporter of the pre-millenial theory of the coming of Christ, and is an ardent advocate of the Revisionist movement. He is the author of ‘Ecce Deus Homo’; ‘Christ the Teacher of Men’; ‘The New Life’; ‘Confidence in Christ’; ‘Manifold Ministry of the Holy Spirit’; ‘Predestination,’ and ‘Blessed Hope of the Lord's Return.’ He has contributed also to numerous journals.

PIURA, pē-oo'rä, a river, department or province, and city of northern Peru. (1) Rio de Piura, or Sechura, rises in the coast cordillera scarcely 100 miles from where it empties into the Pacific at a point nearly due west from its source, but by its great sweep to the north around the Sechura Desert makes its actual length nearly 200 miles. It is called Huarmaca in its upper course, and near Sechura Bay and below Sechura Desert is named the Sechura. It is navigable from February to June. (2) The department, in the extreme northwestern corner of Peru, is bounded by Ecuador to the north, the department of Loreto to the east, Cajamarca to the southeast, Lambayeque to the south and the Pacific to the west; and has an area of 16,825 square miles. The mountains on the eastern border and the cordillera of the coast are rich with pasture grasses; the coast is practically a desert, but has rich mineral deposits of petroleum, salt and soda. Pop. about 250,000. (3) The capital city of the department, 690 miles northwest of Liuca, and 80 miles southeast of Cape Blanco, on the western bank of the river, is connected by rail with Payta, its harbor, which has a population of 3,500. The surrounding country grows a fine grade of cotton. The other exports of the city are salt, hides and cinchona bark. It is a trade centre for the northern valleys of Peru and southern Ecuador. There is a chamber of commerce and a bank. Pop. (estimated) 15,000.

PIUS, pī'ŭs, the name of 10 popes, as follows:

Pius I, Saint: d. 155. Little more is known of him than that he succeeded Hyginus about 140, and died about 154. His day is 11 July.

Pius II (Æneas Sylvius Piccolomini, ē-nē'as sĭl'vĭ-ŭs pĭk-kō-lŏm'ē-nē): b. Corsignano, near Siena, 18 Oct. 1405; d. Ancona, 14 Aug. 1464. He belonged to an illustrious family and in 1431 assisted at the Council at Basel as secretary. He was subsequently secretary to the antipope Felix V, and then to the Emperor Frederick III, by whom he was employed on various embassies. Eugenius IV made him apostolic secretary and by Nicholas V he was made bishop of Trieste in 1447 and sent as nuncio to Bohemia, Moravia and Silesia. He became bishop of Siena in 1449 and Calixtus III created him cardinal 18 Dec. 1456. Early in his career he was a liberal in ecclesiastical matters, but he now became a staunch upholder of papal authority both in opposition to the secular power and to the authority of councils. He was one of the most learned men of his day and distinguished by moderation and a conciliatory spirit. He succeeded Calixtus III 19 Aug. 1458, and in the next year assembled a congress at Mantua to plan a crusade against the Turks, but nothing of importance was then accomplished. He is best known at the present day by his writings, and as author and scholar furnishes an excellent example of the learning of the Renaissance. His works include ‘History of Bohemia’; ‘Cosmographia’; ‘History of the Council of Basel’; ‘History of Frederick III,’ etc. Consult Lives by Voigt (1856-63) and Weiss (1897); Creighton, ‘Historical Essays and Reviews’ (1902).

Pius III (Francesco Todeschini, frăn-chĕs'kō tō-dĕs-kē'nē): b. Siena, 29 May 1439; d. 18 Oct. 1503. He was a nephew of Pius II, by whom he was made bishop of Siena and subsequently cardinal. He was elected Pope in succession to Alexander VI on 22 Sept. 1503, but died only 26 days afterward.

Pius IV (Giovanni Angelo de' Medici, jō-văn'nē ăn'jā-lō dā mā'dē-chē): b. Milan, 31 March 1499; d. 9 Dec. 1565. He studied medicine and law, but subsequently entered the Church and was made an archbishop in 1545 and cardinal in 1549. Ten years later (26 Dec. 1559) he succeeded Paul IV in the papal chair. The most important event of his pontificate was the reopening of the Council of Trent. In 1564 he published a bull confirming the decrees of this council. The confession of faith known as the Creed of Pius IV (q.v.) was put forth by him as a statement of the dogmas defined in the council.

Pius V, Saint (Michele Ghislieri, mē-kā-lā gēs-lē-ā'rē): b. Bosco, near Alessandria, Italy, 17 Jan 1504; d. 1 May 1572. He entered the Dominican Order at 14 and was so distinguished by austerity of his life, and his zeal against heresy, that he was appointed inquisitor in Lombardy, and in 1558 inquisitor-general. He was created cardinal in 1557, and succeeded Pius IV, 7 Jan. 1566. He at once began to enforce reforms with great vigor and aroused much opposition by his seizure, imprisonment and burning of persons convicted or suspected of heresy, among whom were several men of note. He reissued the bull, «In cœnam Domini,» and expelled the Jews from the states of the Church, excepting only the cities of Rome and Ancona. The victory over the Turks at Lepanto was largely the result of the efforts of Pius V, who organized with Venice and Spain the Holy League against them. He was canonized in 1712. Consult Falloux, ‘Histoire de Saint Pie V’ (3d ed., 1858).

Pius VI (Giovanni Angelico Braschi, jō-văn'nē ăn'jāl-ē kō brăs'kē): b. Cesena, Italy, 27 Dec. 1717; d. Valence, France, 29 Aug. 1799. He was made a cardinal in 1773 and succeeded Clement XIV 15 Feb. 1775. He immediately instituted reforms in the public treasury, and next completed the museum in the Vatican, but his greatest work was the draining of the Pontine marshes. When the Austrian emperor, Joseph II, decreed that all the religious orders in his dominions were free from papal jurisdiction, Pius, apprehensive of the consequences of such a measure, went in person to Vienna in 1782, but his remonstrances were futile. At the time of the French Revolution the Pope having favored the allies, Bonaparte entered the papal dominions and compelled him to purchase a peace. Basseville, an agent of the republic to Rome, aroused so much hatred that he was presently slain by the populace. The French forces under Duphot attempted to restore order, but the papal soldiers routed them, and Duphot was slain. Bonaparte accordingly entered Italy, made the Pope prisoner and plundered the city. The aged Pontiff was then carried away by the victors, and hurried over the Alps to Valence, where he died.

Pius VII (Gregorio Barnaba Chiaramonti, grā-gō'rē-ō bär'nä-bä kē-ä-rä-mŏn'tē): b. Cesna, Italy, 14 Aug. 1740; d. 20 Aug. 1823. He was a Benedictine monk who became hishop of Tivoli and was created cardinal in 1785. He succeeded Pius VI 14 March 1800 and the next year concluded at Paris a concordat with France. In 1804 he went to Paris and crowned Napoleon emperor, but after the seizure of Ancona the quarrel between Napoleon and the Pope began. On the annexation of the states of the Church to the French Empire in 1809 the Pope published a bull of excommunication against the perpetrators of the invasion. He was then arrested and sent to Savona, and afterward to Fontainebleau, and was not permitted to return to Italy until January 1814. The Congress of Vienna restored the states of the Church to the Pope, who applied himself thenceforth to internal reforms. He re-established the Order of the Jesuits in the year of his return to Rome. The character of Pius VII was such as to win him the esteem and sympathy of men of views the most diverse. Consult Artaud, 'Histoire du Pape Pie VII' (1836); Celani, 'Il Viaggio di Pio VII a Parigi' (1893) and 'Life' by Allies (1901).

Pius VIII (Francesco Xaviero Castiglione, frän-chĕs'kō zä-vē-ā'rō käs-tēl-yō-nā): b. Cingoli, near Ancona, Italy, 20 Nov. 1761; d. Rome, 1 Dec. 1830. After being successively bishop of Montalto, Cesena and Frascati, he became cardinal in 1816 and Pope in succession to Leo XII, 31 March 1829. During his short pontificate of one year he condemned the slave trade in Brazil, opposed civil marriages in Prussia, denounced Freemasonry and secured the organization of an Armenian archbishopric at Constantinople. Consult Artaud, 'Histoire du Pape Pie VIII' (1844).

Pius IX (Giovanni Maria Mastai-Ferretti, jō-vän'nē mä-rē'ä mäs'tä-ē-fĕr-rĕt'tē): b. Sinigaglia, 13 May 1792; d. Rome, 7 Feb. 1878. He belonged to a noble Lombard family. He was educated at the College of Volterra, and in 1815 became one of the Guardia Nobile of the Vatican, but soon after entered the Church, and lived for a few years in Rome as the head of a large orphanage. Not long after the death, in 1823, of Pius VII he was appointed by Leo XII a prelate in his household; in 1827 was created archbishop of Spoleto, and five years later transferred to the see of Imola. At Imola he showed himself zealous in good works and possessed of liberal convictions. He was raised to the cardinalate in December 1840, but continued to reside in his diocese till 1846, when, shortly after the death of Gregory XVI he was elected Pope, 16 June. In honor of his patron, Pius VII, he assumed the name of Pius IX (Pio Nono). He ushered in his reign by liberating 2,000 political offenders imprisoned by his predecessors, and granted a general amnesty, restoring all prisoners and exiles to their civil rights on their signing a declaration of allegiance. He also established four new dioceses in the United States at Albany, Buffalo, Cleveland and Galveston, all in 1847. In later years he established nearly 50 others in medium-sized American cities. He also (in 1848) drew up a scheme of representative government, with two chambers, a free press and a national guard. These and similar measures for a brief period secured him boundless popularity. But the Italians wished to drive out the Austrians. The Milanese overpowered Radetzky, Charles Albert led the Piedmontese to the Minico, and the youth of all Italy rose to the rescue. Matters were now going too fast and too far for Pius, who refused to countenance the revolutionary movement, and as a result Charles Albert was overpowered in Lombardy, while Naples, Tuscany, Parma and Modena had their newly-acquired freedom quenched in blood. The Pope now entirely lost the favor of the Roman populace. Threatened by the mob in his own palace he fled to Gaeta, and a Roman republic was proclaimed in February 1849, with Mazzini at its head. Louis Napoleon, determined to restore the Pope, sent an expedition to Rome under Oudinot, by whom the Italian patriots, led by Garibaldi, were overpowered. Rome surrendered on 3 July; but the Pope did not return to his capital till April 1850. After his return his government lost much of its personal character, and became reactionary. He now placed his whole confidence in Antonelli, a prelate who had risen to distinction under Gregory XVI and whom Pius had made a cardinal and a member of his council of state in 1847. Antonelli preserved the ascendency in all matters of state till his death in 1876. The Pope himself now bestowed his whole attention upon the Church. He recalled the Jesuits, canonized saints and defined two dogmas. The doctrine of the immaculate conception of the Virgin Mary was defined in 1854; that of the infallibility of the Pope, when speaking *ex cathedra* on a question of faith or morals, was proclaimed in the great Ecumenical Council held in the Vatican in 1870. Previous to this time the Pope's temporal dominions had become sadly shrunken in extent, owing to the gradual unification of Italy under Victor Emmanuel. (See Italy). The temporal power of the Pope, however, was still secured by the presence of a body of French troops at Rome. But after the defeat of Napoleon III at Sedan these were withdrawn. On 20 Sept. 1870 the Italian troops entered Rome, and the temporal power was at an end. The Vatican was left to the Pope; and free diplomatic intercourse, the honors due to a sovereign, and a civil list of £129,000 yearly, secured to him. But these he declined, and confined himself to the Vatican and its garden, declaring that he was under restraint and a prisoner in his own palace. Consult Pougeois, 'Histoire de

Pie IX’ (1877–86) and Lives by Maguire (1878); Shea (1878); O'Reilly.

Pius X (GIUSEPPE SARTO, joo-sĕp'pā sär'-tō): b. Riese, 2 June 1835; d. 20 Aug. 1914. He was elected to the papacy by the College of Cardinals, 4 Aug. 1903, after the conclave had been in session five days and assumed the title of Pius X. He was born in a small Venetian town, of a humble peasant family. His father died 4 March 1842, and his mother, Margarita Sanson, 2 Feb. 1894, after a life of labor and sacrifices, entailed in rearing her family of nine children, eight of whom were living at the time their brother was made Pope, all in humble circumstances. There were two brothers and seven sisters. When young Sarto became a parish priest his mother was too humble to live with him, but his unmarried sisters resided with him at the patriarchal palace in Venice. He made his elementary studies at Castelfranco, a small town not far from Venice and thanks to the interest shown in him by Cardinal Monico, patriarch of Venice, was enabled to continue his education. He was ordained priest 18 Sept. 1858 by special dispensation of Pius IX, and was appointed assistant priest at Tombolo, from which place he was transferred in 1867 to Salsano as parish priest. His zeal, piety and well-directed energy led to subsequent appointment to such important ecclesiastical dignities as spiritual director in the seminary, judge of the ecclesiastical tribunal and vicar-general of Treviso. In 1884 he was consecrated bishop of Mantua, in Lombardy, where he remained for nine years. On 12 June 1893, Pope Leo XIII created him cardinal with San Bernardo alle Terme as his titular church and very shortly after this he was made patriarch of Venice, whence, nine years later, he was summoned to Rome to elect a successor to the papal throne, made vacant by Leo's death, and was chosen as that successor, 4 Aug. 1903.

Pius X is a striking example of the bestowal of the highest dignity in the Roman Catholic Church upon one of the lowliest origin, utterly void of ambition, whose career had been marked only by the sincerest piety and indomitable zeal in the practice of his ecclesiastical profession. His elevation is an apotheosis of the parish priest. There could be no more marked contrast than that presented by this Pope and the Pope whom he succeeded. Leo XIII was of aristocratic birth, a scholar, a diplomat. Pius X had the lowly peasant spirit which characterizes his whole family. He deprecated his elevation to the bishopric of Mantua and was prostrated by his election to the papacy, accepting it only through sense of duty. Although speaking and knowing his own language with classical finish, he was familiar with no other except for a slight knowledge of French and German. He was known throughout Italy by his work for societies and for his schools. His ardor for missionary work drew to him the attention of all who were interested in this field. He exacted observance of discipline although he was indifferent to ceremony and the punctilious observance of mere form and conventionalities. He was a staunch advocate of the Gregorian chant, which is in keeping with his insistence on liturgical observance. In his first encyclical given two months after his accession, the Pope declared that «we have no other program in the Supreme Pontificate but that of restoring all things in Christ (Eph. i, 10), so that ‘Christ may be all in all’» (Col. iii, 2).

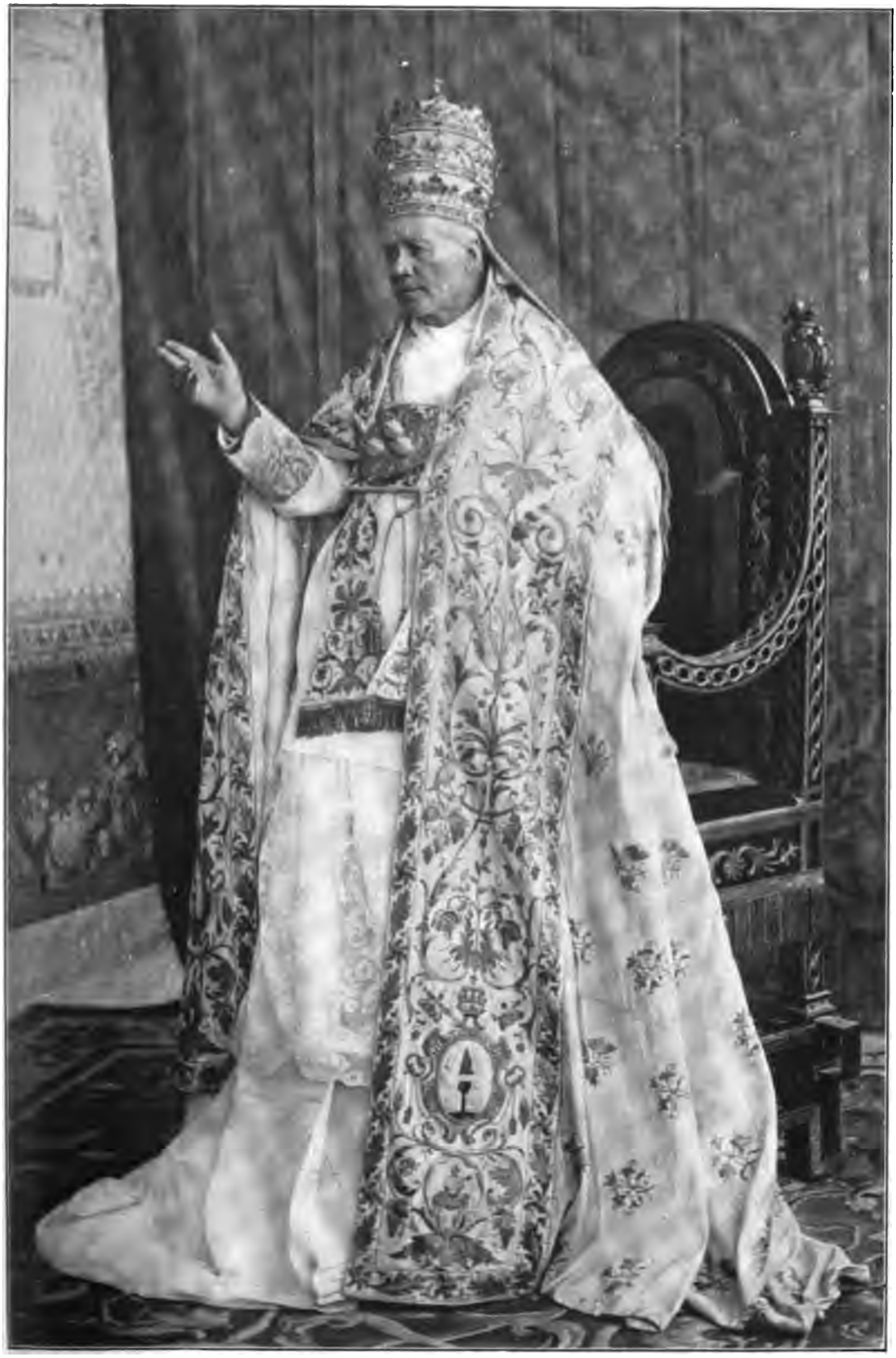
One vigorous measure of Pius X shortly after his elevation to the papacy was to abolish the «veto» which three Catholic Powers enjoyed in the election of a Pope. He drew up a document in which excommunication is pronounced ipso-facto against any one who acts as the intermediary of any power in proposing a veto against any cardinal during a conclave. Despite his unflinching attitude toward all that involves the authority, teaching and dignity of the Church, Pius X was personally friendly toward Queen Margherita, with whom he became acquainted when bishop of Mantua and toward King Victor Emmanuel and Queen Helena, whom he received at the patriarchate in Venice on their visit to that city.

The Venetians were surprised that the Pope did not assume the title of Benedict, as one of the seven popes who, like himself, were from the province of Venice, was Benedict XI (Boccassini, 1303–04). This Pontiff was born at Treviso, with which town Cardinal Sarto had been connected by his labors as priest. Benedict also, like himself, was of humble origin and of lowly spirit.

Pius X was a handsome man of fine physique, with blue eyes and silver hair, a most sincere and lovable face, and possessed a sonorous voice of great volume, something of special value to one who is distinguished by zeal for preaching. The arms of this Pope are an anchor resting on the waters and a radiant star. This and the fact that he was elected on the day of Saint Dominic have recalled the title applied to this Pope by the prophecy of Saint Malachy: «Ignis Ardens» (a blazing fire). The arms of the Dominicans have a dog (Domini Canes) bearing a blazing torch. He displayed great restraint when relations were broken off with the French government. In 1907 he issued the encyclical «Pascendi,» condemning Modernism. He advocated increased study of the Bible and the codification of the canon law. In 1910 he issued a decree barring the clergy from the temporal administration of social organizations, as this had often been the foundation of serious annoyances. He was most energetic in raising funds for the sufferers of the great earthquake of 1907 and secured $1,400,000 for them. Consult ‘Life of Pope Pius X,’ with preface by Cardinal Gibbons (New York 1904); ‘Giacomello, Pio X’ (Padua 1908).

PIUS IV, Creed of, a dogmatic fomula of the Roman Catholic Church, announced by Pope Pius IV in his bull ‘In Sancrosancta’ (1564). It was prepared by a commission of the Tridentine Council. A formal acceptance of it is required by the Church from all converts, teachers and priests. The contents may best be ascertained by consulting the full text given in Schaff's ‘Creeds of Christendom’ (1877–78).

PIUS IX, Order of, a papal order of merit of two classes founded by Pius IX, in 1847. It is conferred on the nobility in recognition of virtue and desert. The uniform is of blue with red facings and gold embroidery and the decoration is a hexagonal blue star with gold flame between the arms, bearing upon the obverse,



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HIS HOLINESS POPE PIUS X WITH PAPAL CROWN AND ROBES OF STATE

«Pius IX,» surrounded by the motto «Virtuti et Merito.»

PIUTE (pī'ūt) **INDIANS**, a name given various small tribes of American Indians of the Shoshone family residing in southwestern Utah, Nevada, Arizona and southeastern California. There are about 5,000 of them who have been known by the name, most of whom are beyond the jurisdiction of the Indian agencies. The United States official records recognize but 750 of them. The Piutes in different localities are known as Paviotos, Chemehuevis, Pautis and Numas. See SHOSHONE INDIANS.

PIZARRO, pĭ-zä'rō (Sp. pē-thär'rō), **Francisco,** Spanish adventurer, the discoverer and conqueror of Peru: b. Truxillo, Estremadura, about 1471; d. Lima, Peru, 26 June 1541. The spirit of adventure which in his time pervaded Spain induced him to seek his fortune in the newly-found continent of America. He was in Darien in 1509 and afterward was connected with Balboa when the latter discovered the Pacific (1513). Subsequently he became associated with Hernando Luque, a priest possessed of some money, and Diego de Almagro, an adventurer like himself, and having jointly fitted out an expedition the associates set sail from Panama on a voyage of exploration and conquest along the coast to the southward (1524). Their first voyage was unsuccessful, but learning the existence of the rich empire of Peru they were not long in making a second voyage, with the intention of conquering this country. Their forces were too few, however, for this object, and Pizarro determined to seek assistance in Spain. After encountering tedious delays and obstacles he obtained from the queen a commission bestowing on him the right of discovery and conquest in Peru, with the rank and title of governor and captain-general of the province. Raising a small force in Spain, he recrossed the Atlantic (in 1530), and January 1531 sailed from Panama with three vessels and a force of 185. Taking advantage of a civil war then raging in that country, the Spaniards became the allies and eventually the enslavers of Atahualpa, the successful contestant for power. What has been ascribed to treachery on the part of Pizarro in dealing with Atahualpa has proved, in the light of recent historical research, to have been a justifiable and necessary policy in the Spaniards' defense against the Indian chief's fully planned conspiracy against their lives. The ransom offered and paid by Atahualpa for his release amounted to some $8,000,000 and not to $17,000,000 as commonly and erroneously stated. The news of their success brought a considerable accession of strength from Europe to the invaders. The Inca Manco was allowed to reign as a do-nothing monarch. Pizarro was made a marquis and in order to consolidate his empire founded, in 1535, the city of Lima, which he intended as the capital of his possessions. But the discord which had long existed between Almagro and Pizarro at last broke out into open violence, and in the struggle which ensued Almagro was defeated, taken prisoner and killed. This catastrophe, which took place in 1538, was avenged by partisans of Almagro, who conspired against Pizarro and murdered him in his palace at Lima. The character of Pizarro has been largely rehabilitated by the new school of the historians of the Spanish conquests. He is now acknowledged to have been not only a man of remarkable military genius, but of great integrity and high moral purpose. Consult Prescott, ‹Conquest of Peru› (1847); Markham, ‹Peru› (1893); Lummis, ‹Spanish Pioneers› (1893); Ober, F. A., ‹Pizarro, and the Conquest of Peru› (1906).

PIZARRO, Gonzalo, Spanish adventurer: b. Truxillo, Estremadura, about 1506; d. Cuzco, Peru, April 1548. He was half-brother of Francisco Pizarro (q.v.) whom he accompanied on a second visit to Peru in 1531. In early life he had signally distinguished himself as a soldier and when he reached the New World was acknowledged to be the best lance in Peru. His talents were exclusively those of a guerrilla chief, as he lacked the military and civil capacity of Francisco. He subdued Charcas (Bolivia), obtained a grant of the mineral district about Potosi and grew rich. In 1540 he was appointed by Francisco governor of Quito and directed to undertake an expedition toward the east, where a land supposed to be extremely rich in spices was reported to lie. He set out on the expedition across the Andes, during which he was deserted by Orellana (q.v.), who discovered the headwater of the Amazon and descended that stream to the ocean. The expedition occupied two years and greatly thinned the ranks of the adventurers by its hardships. After the assassination of Francisco, Gonzalo raised an army and advanced upon Lima to attack Nuñez Vela, the new and unpopular viceroy sent out from Spain. He was warmly supported by the bulk of the colonists and many of the royal troops. On 18 Jan. 1546 a battle took place at Anaquito near Quito, in which Nuñez was defeated and slain. But in the following year Pizarro was attacked by an army sent from Spain under Pedro de la Gasca and was eventually defeated, taken prisoner and executed.

PLACE, Victor, Franch Assyriologist: b. Paris, 1819; d. 1875. In 1839 he began his connection with the Foreign Office and was successively consular agent at Naples, Gibraltar and Haiti. In 1851 he was removed to Mosul as consul and continued the excavation projects inaugurated by his predecessor, Botta, at Khorsabad. Many valuable Assyrian remains were uncovered. Some of the trophies were lost in the river by accident. In 1855 Place was transferred to Jassy, Moldavia, but his abuse of power and greed for gold soon caused his removal to Adrianople, whence in 1870 he was transferred to New York. Here he was engaged in purchasing munitions for France in the war with Prussia, and by purchasing defective material and charging a high price to his government, he enriched himself to the extent of over 600,000 francs, when he was discovered, indicted, tried, convicted and sentenced to two years in prison. President Thiers afterward commuted the sentence. Place published ‹Ninevié et l'Assyrie› (2 vols. text; 1 vol. plates, Paris 1867–70).

PLACENTA. See EMBRYOLOGY; OBSTETRICS.

PLACER DEPOSITS, deposits of the metals or valuable minerals in fragmental form associated with coarse sand or gravel. The common minerals to be found in this way are gold, platinum, tin and monazite, though other placer deposits are known. Placer deposits originate from the weathering of rocks in which these minerals occur. As the valuable minerals are heavier than the waste rock, they are gradually segregated by the carrying away of the finer or lighter material. The gold placers of California and Alaska constitute familiar examples. The valuable minerals are secured by washing the gravels either by hand (panning) or other means.

PLACER MINING. See Gold Mining.

PLACERS, *in mining,* deposits of valuable minerals, found in small particles in the beds of streams and on lakes and seashore. The principal metals so found are gold, tin, chromium, iron and precious stones. According to the legal classification of mines in the United States all mineral deposits other than veins of rock in place are placers. Placer ores, being heavy, when freed by the decomposition of the containing rock, mingle with the materials carried down by running streams and settle to the bottom where the current slackens. Magnetite is the commonest of the ores found in placers, and the frequency of gold and platinum in it gives it a high commercial value. See Gold; Mining.

PLACET, plā'sĕt, or **PLACITUM,** plăs'ĭ-tŭm (*placitum regium*), the assent of the civil power to the promulgation of pontifical ordinances within its jurisdiction; called also *exequator.* The right to exercise supervision over communications of the Holy See with bishops, clergy and people of sovereign states and to prevent or suspend the promulgation of bulls, letters apostolic and other papal instruments, unless they have received the approval of the secular state itself, is asserted in the famous ‹Declaration› of the Gallican clergy (1682); and in the various German states it is embodied in the constitutional law: this is no less true of Catholic states than of Protestant. The exercise of the right was carried to extreme lengths by the Emperor Joseph II (reigned 1765–90) who asserted for himself a supremacy in the administration of Church affairs. And not only ordinances emanating from Rome but even those of the local bishops were made subject to censorship by the secular authority. The see of Rome has never admitted as a matter of right the claim of the state to impede the execution of papal ordinances; but to prevent greater evils it has generally acquiesced in the exercise of this power. All the Catholic states of the continent of Europe claim and exercise the right. In the kingdom of Prussia in the years 1873–75 very stringent laws were enacted (Falk laws, May laws) to control the Catholic bishops and clergy, the Catholic theological seminaries and the Catholic Church discipline. A newly-ordained priest was made liable to fine and imprisonment if he proceeded to the work of his ministry without the *placet* or *exequatur* of the Minister of Worship; or confessors incurred the like penalties for refusing absolution under certain circumstances to penitents; in 1884 there were in the one diocese of Breslau 119 priests who had incurred the penalties; but the government intervened and the penalties were remitted; afterward all of the Falk laws were either repealed or mitigated essentially.

PLACETAS, plä-sä'täs, Cuba, town, province of Santa Clara, 20 miles southeast of the city of Santa Clara. It is in a fertile sugar district, is connected with Camajuani, and the seaports of Sagua La Grande and Caibarren by rail. Pop. about 6,500.

PLACOIDEI, plā-koi'dē-ī, the name of an obsolete grouping of fishes, including those with placoid scales. See Fish.

PLAGAL, *in music,* the name given by Gregory the Great to the four collateral scales which he added to the four authentic scales of Ambrose. The term plagal is now applied to melodies in which the principal notes lie between the fifth of the key and its octave. The plagal cadence consists of the chord of the subdominant followed by that of the tonic. See Music.

PLAGIAULACIDÆ, plā"jĭ-â-lăs'ĭ-dē, a family of fossil, multituberculate mammals, whose fragmentary remains occur in formations from the Triassic to the Tertiary periods in both Europe and North America. These remains are chiefly of jaws and molar teeth, in many respects foreshadowing those of the marsupials. The typical genus is *Plagiaulax;* others are *Allodon, Bolodon* and *Ctenacodon.* This family, says Woodward, does not seem to have become extinct until early Tertiary times, the genus *Ptilodus* occurring in the Puerco (Eocene) beds of New Mexico. Whether the South African genus *Microlestes,* often associated with these genera, really belongs here is disputed, many palæontologists regarding it as reptilian. Consult Woodward, ‹Vertebrate Palæontology› (1898); Beddard, ‹Mammalia› (1901).

PLAGIOCLASE, a group of triclinic feldspars (q.v.) in which the two prominent cleavage-directions are oblique to each other. The designation was adopted by Breithaupt. In the group are included anorthite, albite, oligoclase, labradorite.

PLAGIOSTOMI. See Fish; Ichthyology.

PLAGIUM, *in Roman law,* the crime of stealing the slave of another, or of kidnapping a free person in order to make him a slave. According to German law it is the getting forcible possession of a man's person, so as to restrain him of his liberty. By Scotch law the crime of stealing an adult person was punishable with death, and the same punishment has been applied to the stealing of children.

PLAGUE, History of the. The plague, so-called, has been a general name for centuries for any prevailing sickness that carried off great numbers of people. While all the instances recorded below are spoken of as «the plague» it is probable that several diseases have figured in the records. See Black Death; Bubonic Plague (concerning the modes of communication of the plague), very different opinions have been entertained, according to the state of medical science. In early times, when calamitous events, the causes of which were not understood, were attributed to spirits and demons, the plague was also ascribed to their influence. At a later period it was accounted for by changes in the air, by poisonous vapors which descended from the atmosphere, or was attributed to clouds of insects which were received into the body by inspiration, or in the food, or by absorption through the skin, thus corrupting the blood. There are certain conditions which have always attended outbreaks of the plague. The chief of these are unwholesome and insufficient food, overcrowding, bad ventilation, accumulation in the neighborhood of dwellings of decaying animal and vegetable refuse. In short, these conditions may be summed up in the words, "poverty and bad sanitation." The cold weather of northern latitudes has been observed to check the advance of plagues. In Europe the late summer and autumn months have been marked by its deadliest ravages. It is endemic in certain localities of Asia (parts of Mesopotamia, India, China), and when it has appeared in Europe it seems always to have been traced to the East. It has often been carried by ships, no doubt by one or other of the crew being infected, and not by the merchandise.

There is little doubt that the plague appeared in the most ancient times, particularly where a numerous population was crowded together in the warm climates; but we must not consider every disease as the plague which has been so called by historians, as they often mean by the term nothing more than a malignant disorder prevailing over a considerable extent of country. Among the most famous instances is the plague described in so masterly a manner by Thucydides, which, in the second year of the Peloponnesian War (430 B.C.), ravaged Athens, then besieged by the Spartans. A large number of the inhabitants of Attica had fled into the city. Fear, anxiety, want or poor provision and the corruption of the air caused by the crowded state of the population, produced and propagated the disease in the city. Death generally ensued on the seventh or ninth day. This epidemic does not seem to have been the real Oriental plague, however, any more than that which prevailed in Jerusalem (72 A.D.) when it was besieged by the Romans, as described by Josephus. In Rome the plague existed (77 A.D.) in the reign of Vespasian; of Marcus Aurelius (170), when it raged over almost all Europe and Asia (but this was probably not the real plague); of Commodus (in 189); and particularly of Gallienus (in 262), when 5,000 persons are said to have died daily in Rome. In Constantinople, in the reign of Justinian (in 544), it raged so violently that 1,000 grave-diggers are said to have been insufficient for the interment of the dead. This terrible plague continued its ravages for 50 years with but short intervals. In 565 it appeared under the name of *pestis inguinaria* in Trèves; in 588 in Marseilles. From the descriptions of this visitation given by contemporary writers it was evidently the true Oriental plague, and it had spread over Egypt before reaching Europe. Great mortality from it resulted not only in Constantinople but also in Italy, Gaul and other countries, including northern Africa.

In the 7th century the plague or other serious epidemic raged in Saxony; in 823 it prevailed all over Germany, and from 875 to 877 was particularly malignant in Saxony and Misnia, as was also the case in 964. In the 11th century it broke out in Germany at least six times, mostly after or during a famine, and raged with so much violence that it was believed that all mankind was doomed to be swept away by it. This unfortunate belief prevented the taking of effectual means to check it, and apathy in suffering was considered as an act of piety. In some cases, however, the Jews were suspected of having poisoned the wells, as in a time not very remote the Hungarian peasantry suspected the nobility when the cholera swept away so many of the poorer classes. In the 12th century the plague prevailed in Germany above 25 years. In the 13th century it was brought into Europe by the Crusaders. At the middle of the 14th century it traversed all Europe, and was then called the Black Death. The black death was carried to Europe from the East, having been transmitted, it is said, from Tartary, and ultimately from China, to the Crimea, whence it was carried to Italy by certain Genoese. It also reached Egypt and thence northern Africa. In England it broke out first in the west in 1348, and then spread over the rest of the country, including Ireland and Scotland, its ravages being severest in the towns. After causing an immense number of deaths it reappeared in 1361 and 1369. The black death was the most serious epidemic ever known to have afflicted Europe. In England the proportion of deaths amounted to a third, or even a half, of the whole population. Some towns lost almost all their inhabitants; in Oxford two-thirds of those connected with the educational institutions perished; in London the deaths amounted to 100,000, in Norwich to 60,000. The mortality was naturally greatest among the lower orders; while the clergy and religious orders suffered to an equal or greater extent, no doubt from their efforts on behalf of their suffering brethren. Of those attacked some died almost immediately, others within 12 hours, almost all succumbed within three days. It appears to have been at its height in the summer of 1349. The consequences left behind were great and far-reaching. One was that laborers were so scarce that wages went up to double their former rate, thus leading to the passing of acts intending to regulate them, which had little result except to stir up ill-feeling, ultimately culminating in Wat Tyler's insurrection. Another consequence was the breaking up of many estates into farms let on lease, owing to the scarcity of hired labor by which they could be cultivated under their owners' management. A great accession to the land owned by the Church was another consequence of the black death, which long remained a landmark in English social history. Since that time the plague has never raged with so much violence.

Boccaccio, in the introduction to his 'Decameron,' has given a vivid description of its physical and moral effects in Florence in 1348. In the 15th century it raged in Europe on several occasions, and was accompanied with dreadful sufferings. The historians of that time give terrible pictures of distress. London suffered severely both at the beginning of the century and again in 1428, while a serious outbreak took place in 1472 and subsequent years. In the 16th century the plague again raged, and in 1563 was introduced into England by the return of an English army from the Continent. Though some means were already taken against the plague — for instance, lazarettos built — yet it raged in Europe on various occasions and in different countries during the 17th century. Holland suffered from it in 1603; in the same year Egypt lost by it about 1,000,000 of its inhabitants. In 1630 Milan was ravaged by it; in 1635–37 Holland again suffered; in 1656 Italy had a dreadful visitation, during which 300,000 persons are said to have died in Naples, 60,000 in Genoa, but only 14,000 in Rome, owing to superior sanitary measures and precautions. On this occasion it spread also to Spain, Germany and Holland. In 1603, 1625, 1636 and 1665 it made great ravages in England. In 1603 there are said to have been 38,000 deaths in London; in 1625, 35,000; in 1636, over 10,000; while 1665 is known as the year of the "great plague" in London, so graphically described, with perhaps some coloring, by Defoe. During the year the deaths are given at nearly one-seventh of the population. The disease spread somewhat widely over the country both in this and the following year. The cessation of the plague in London was attributed to the great fire, and though this no doubt had its local effect, still there was a similar disappearance of the epidemic not long after this time in western Europe.

In 1679 Vienna lost 76,000 of its citizens by this scourge; in 1681 Prague lost 83,000; and various German cities suffered severely. Early in the 18th century the plague caused many deaths in eastern and central Europe, the number in Prussia and Lithuania being set down at 283,000. On this occasion it extended its ravages into northern Europe, Copenhagen and Stockholm having both suffered, the latter to the extent of 40,000 deaths. In Constantinople and other places in the Levant it frequently raged during this century, and in 1720–21 Marseilles and part of southern France were ravaged by the epidemic brought from this quarter. The deaths in Marseilles alone are said to have numbered from 40,000 to 60,000; thousands of corpses lay unburied in the streets. In 1770 it raged in Moldavia, Wallachia, Poland and other adjacent regions, and in 1771 it carried off over 40,000 persons in Moscow, or one-fourth of the whole population. During the 19th century it made itself felt on several occasions in Constantinople and other parts of eastern Europe, in Asia Minor, Syria, Mesopotamia, Arabia, Persia, Egypt and northern Africa, but nowhere did it affect a very wide area. In 1834–35 great mortality was caused in Egypt. It also carried off many thousands in Mesopotamia between 1873 and 1877. In 1878–79 the plague made its appearance on the lower Volga, where it caused a considerable number of deaths.

India has often been visited by this terrible disease, and hundreds of thousands have at various times succumbed to it in that country. In September 1896, several cases were recognized in Bombay, and during the succeeding nine months the disease raged in the city with such severity that the majority of the inhabitants fled to neighboring towns and villages. Poona and Karachi were attacked by the end of 1896, and the disease also spread to more distant parts. A special commission of experts was appointed by the Indian government, and vigorous measures, such as house-to-house visitation, thorough disinfection, and enforced isolation, were adopted. The native municipality of Bombay was for plague purposes superseded by a plague committee. In February 1897, an international sanitary conference regarding the plague sat at Vienna, and after discussion came to the conclusion that the disease was caused by a bacillus discovered in 1894 by Kitasato and Yersin. They also gave countenance to the view that rats, mice and certain other animals, which were liable to attack, probably contributed largely to spread the disease. Bombay was again visited by a serious epidemic in the autumn of 1897, which reached a climax in February of the following year, when the deaths from plague numbered 250 per day. This outbreak also spread to other parts of India, especially in the Bombay presidency, but it was virtually over by June. The sanitary measures of the authorities came into collision with native beliefs and prejudices at various points, and on 9 May 1898 serious riots broke out in Bombay and elsewhere. This led the government to abandon all the more stringent and severe of their preventive measures, and the fact that no harm resulted from their action seemed to justify the statement that the disease takes its own course whatever may be done. Calcutta was first visited by the plague on 16 April 1898, and soon a considerable number of cases were recorded. Bangalore and some other places in southern India suffered severely, and in August, Bombay was again seriously affected. This renewed outbreak passed off in due course only to be succeeded by another, extending from February to July 1899. In 1899 Calcutta was revisited, and other parts of India still continued to lose many lives by this scourge. The plague reached Madagascar in November 1899, and this is the first authentic record of its appearance south of the equator. It was soon afterward reported from Réunion, Mauritius, German and Portuguese East Africa, and West Africa. In July of that year some Spanish sailors arriving at Oporto died of the plague, and it also carried off others in this part of Portugal. The first instance of the plague in the New World was recorded from Brazil in November 1899. Early in 1900 the first case of it was recorded in Australia, but by September that country was practically free from the disease. It has since visited South Africa, and in 1900 there were a few cases at Glasgow. The spread of the plague in India during recent years is shown by the following official figures: In 1897 there were 56,000 recorded deaths; in 1900, 93,000; in 1901, 274,000; in 1902, 577,000. During the single month of March 1903 no less than 136,000 in that country perished from this disease. No city with modern sanitation has suffered from the plague in the 20th century.

PLAGUES OF EGYPT, a succession of inflictions, usually regarded as having been 10 in number, which, according to the Old Testament, were divinely sent upon the Egyptians to compel them to emancipate the Israelites from bondage and allow them to quit the land of Egypt. (Ex. vii. 14, xii. 30. For the use of the word plague, see ix. 14, xi. 1). The first plague consisted in the turning of the waters of Egypt into blood; the second, of frogs that covered the land; the third, of lice annoying both man and beast; the fourth, of grievous swarms of flies; the fifth, of murrain that attacked the livestock; the sixth, of boils “breaking forth with blains upon man and upon beast”; the seventh, a severe thunderstorm accompanied by destructive hail; the eighth, a plague of locusts that ate what the hail had spared; the ninth, a darkness that could be felt; the tenth, the death of the firstborn of man and beast among the Egyptians. Consult Driver, S. R., ‘Commentary on Exodus’ (1911); Selbst, ‘Handbuch zur Biblisch Geschichte’ (Freiburg 1910).

PLAICE, a European flatfish (*Pleuronectes platessa*), allied to the turbot, and highly esteemed as food. It attains an average length of 12 or 18 inches. The dark or upper side is colored brown, spotted with red or orange. They are caught chiefly by means of trawl-nets.

PLAIDS. *A plaid* is a pattern in textile fabrics consisting of bars, or stripes, of color crossing each other at right angles. A *plaid* is a development of the check, which in textile fabrics is a pattern of squares of alternate colors. Properly speaking, a check should have no divisions between the squares more than a thin boundary line. In other words, the pattern should resemble the ordinary chess-board. The word check is derived from an old European custom of settling accounts and computing money by means of counters, or tallies, on a table covered with a checkered cloth. The word comes from the French *échiquier* meaning chess-board.

The *check*, a very ancient pattern, was extraordinarily popular in ancient Egypt as a motive of decoration; and this motive was undoubtedly derived from the woven fabrics and the baskets of plaited reeds and rushes. In the decorations of temples, tombs and houses the Egyptians frequently used a single checker of two colors, dark and light, alternately arranged. Sometimes the form was rectilinear instead of square. Sometimes each square was ornamented by a cross; and in this case the blocks were frequently yellow and green, alternately, and the device (cross) upon them red and black. Occasionally, too, the squares were of various colors arranged in such a way as to form geometrical patterns. Sometimes the squares were cut into halves and the little triangular blocks were grouped so as to make a pleasing effect of form and color. Fabrics, both of linen and wool, exhibited a great variety of motives formed of straight lines — lines horizontal, perpendicular and diagonal. The Egyptians may be said to have “worked the *check* to death.”

The *check* is found in nearly every country, ancient and modern, savage and civilized, as a motive of decoration and as forming a pattern for textiles. Scotland is, however, of all countries the home of the *plaid*, there called *tartan*, and affectionately “plaidie” in song, story and legend. The word tartan is derived from the Gaelic *tarstin*, or *tarsuin*, meaning across, athwart, over or through, which, of course, applies to the crossing of the threads in the weaving of any sort of cloth. The word tartan seems to have been applied in early times to the *material* and not to the *pattern*.

To-day the word tartan includes both material and pattern. The French had the word *tiretaine* in the 13th century for “cloth dyed of a scarlet color.” In a wardrobe account of James III of Scotland (1471) there is mention of an ell and a half of blue tartan to line his gown of cloth of gold. James V of Scotland in 1538 on a hunting excursion into the Highlands wore a suit made of varicolored tartan.

The variegated pattern has also a Gaelic name — “Cathdath,” “war-color,” or “the strife of colors.” Another name is *plodden*. An Englishman visiting Edinburgh in 1598 wrote, “The citizens, wives and women of the country did wear cloaks made of a coarse cloth of two or three colors in chequer-work, vulgarly called *plodden*.” In 1616 Taylor in his “Penniless Pilgrimage” describes the dress of the Highlanders as “warm stuff of divers colors which they call tartan.”

The use of the tartan seems to be beyond the reach of history. The Scotch Highlanders are a remnant of the great Celtic race and were the last to oppose the conquering arms of Rome. When Agricola invaded North Britain in 81 A.D. he found 21 aboriginal tribes, or clans. Clanship, like the tartan which distinguishes its wearers, eludes the historian and disappears in the mists of tradition. The picturesque dress of the

> “Bonneted chieftains all plaided and plumed in their
> tartan array”

is, therefore, one of the most ancient of all costumes.

The clothing of the early Britons was much the same as that of the Gauls. From the Belgic Gauls who settled in Britain, the Britons learned to dress skins, to spin and to weave. The Gauls made several kinds of cloth which they dyed various colors. For the tunic and trousers they used a cloth of mixed colors, forming a check, the prototype of the Scotch plaid. The mantle was generally one color, preferably blue. The Britons were particularly skilful in dyeing; and they used the juice of such plants as the foxglove, sorrel and the famous woad, from which the blue dye was obtained. Color was an important element in British dress. The colors the bards wore were blue, green and white. The Irish Druids wore several colors: the higher the rank, the greater the variety. In Ireland outside the priesthood, color was much esteemed; and the first regulations resembling sumptuary laws in the British Isles were passed long before the Christian Era, ordering the Irish peasantry and soldiers to have their garments of one color only, officers of two colors, commanders of clans, three; and so on. The Royal Family were allowed seven colors. Irish bards wore plaid, or checkered, cloth for their undergarment — a kind of tunic — and over this they threw a long cloak striped in various colors. There is a striking kinship between the Scotch tartan and the checks worn by the Irish in ancient times. In common with the Gauls and ancient Britons the Celts were fond of brilliant colors; and even as far back as 390 B.C. Livy and Virgil assert that these strangers appeared “in flaming tartan garb” before the walls of Rome in that year.

The original dress of the Highlander was the Celtic *Feile-breacan* (belted plaid). This was a piece of tartan about two yards broad and four yards long, which was drawn round the waist in nicely adjusted folds and tightly buckled with a belt. The lower part came down to the knees in much the same manner as the modern kilt, while the upper part was drawn up and adjusted to the left shoulder so that the right arm might be perfectly free. This upper part was the «plaid,» which was used as a covering for the shoulders and body in wet weather. When the use of both arms was required, the plaid was fastened across the breast with a brooch, often curiously enriched. A brooch was also used to fasten the plaid on the left shoulder. To attire himself in the *belted plaid* required on the part of the Highlander no small amount of dexterity. The usual way was to lay it on the floor, or ground, and, after carefully arranging the folds, to lie down upon it and then buckle it on. The lower end was fastened at the right hip. This arrangement appears in the illustration of the Earl of Moray engraved in Lord Archibald Campbell's «Records of Argyll.»

The utility of such a dress in the Highlands is obvious, for the «plaidie» rendered the man indifferent to storms and prepared to pass a night in the open air in the most inclement weather, while the loose undergarment enabled him to wade rivers, or ascend mountains, with equal ease. The plaid was thus peculiarly adapted to the warrior, hunter and shepherd. If benighted, the Highander of old would dip his plaid in water and then wrap it around himself. The woolen cloth, swollen with moisture, was supposed to resist the wind, while the exhalations from the body during sleep surrounded him with a warm vapor.

In Heron's 'History of Scotland' we read that in Argyll and the Hebridæ before the middle of the 15th century tartan was manufactured of one or two colors for the poor, and more varied for the rich. The author of 'Certain Matters Concerning Scotland,' who wrote prior to 1597, said that the «Highlanders delight in marbled cloths, especially that have long stripes of sundry colors; they love chiefly purple and blue.» The particular patterns of tartans which distinguish each clan, must have been fixed before 1645, probably before 1600. Martin noted that the different isles in the west had different patterns of tartans and he also remarked that the women of the Western Isles wore sleeves of scarlet cloth and a plaid tied before on the breast, held with a buckle of silver, or brass, according to the quality of the person. The plaid was white with a few stripes of red, black or blue, reaching from neck to feet and belted with a leather girdle studded with silver. The tartan was worn in this style by ladies in the 18th century and is still so displayed at fancy and costume festivals.

The Highlanders had neither cochineal, foreign woods, nor the many brilliant hues produced to-day; but their native hills yielded wonderful dyes. Every housewife was able to dye red, blue, green, yellow, black and brown with their various compounds. As many of the ancient dyes are still used in the Highlands it is interesting to note from what native flora the dyes were obtained. Black was from alder tree bark, dock root and water fly root; blue, blueberry with alum, or elder with alum; brown, lichen, dulse, currant with alum, blueberry with gall nuts; crimson, white lichen, dark lichen; flesh color, willow bark; grey, root of yellow water-flag; green, broom, whin bark, teasel, heather with alum; magenta, dandelion; orange, bramble; purple, sun dew or cupmoss; red, rock lichen, white lichen, rue root, or tormentil; scarlet, limestone lichen; violet, wild cress; and yellow from bog-myrtle, ash tree root, bracken root, Saint John's wort, teasel, lichen, common heather with alum and sun dew with ammonia.

According to Captain Burt in 'Letters from a gentleman in the North of Scotland to his friend in London,' written in 1730, —: «The chequered stuff commonly worn by the Highlanders, by them called breacan (parti-colored) and by the Lowlanders tartan (French, *tiretaine*), is neither peculiar to Celts nor Goths, and is to be found at this day, although not in such general use, among many of the Slavonic tribes, who have no connection with either.» Captain Burt also says that when the Highlanders are trained to lie among the hills in cold, dry, windy weather, they sometimes soak the plaid in some river or burn, and then holding the corner up above their heads, they turn themselves round and round until they are enveloped in the whole mantle and then lay themselves down on the leeward side of some hill where the wet and warmth of their bodies makes a steam like that of a boiling kettle, and keeps them warm by thickening the stuff and keeping the wind from penetrating.»

For a long period the «belted plaid» was the dress of the Highlanders. Early in the 18th century it was succeeded by the little kilt called the *feile beg*, or *fillibeg*, and was much the same in appearance as the modern kilt worn to-day. The little kilt was made of six ells of single tartan, plaited, sewn and fixed round the waist with a strap, half a yard being left plain at each end and these crossed each other in front. Kilt is a Lowland word signifying a shortened, or tucked-up-garment. The plaid figured largely in Lowland politics. Allan Ramsay, who was throughly Jacobite, supporting the claim of James Stuart to the throne in 1715, wrote a poem «Tartana, or the Plaid,» which specially refers to the wearing of tartan plaids by the ladies, a custom then universal in the Lowlands.

The kilt is worn to-day so that when the wearer is standing erect the edge of it should reach the centre of the kneecap. The kilt is the principal part of the Scottish dress and should be made of tartan associated with the name of the wearer. In absence of any claim to wear a particular tartan, the Royal Stuart tartan can be worn. The shoulder plaid is merely ornamental, but should always be worn with evening dress. The lower end of the plaid is fastened round the waist by a band and the other end is pulled through the epaulette on the left shoulder, where there should be a rosette on the plaid through which a brooch is fixed. This can be of any design provided it is round and may have a Cairngorm, or other stone, in the centre, or it may be made after the pattern of the Lorne brooch.

Stockings used to be made out of the web of tartan but they are now knitted. Tartan ribbons, like stockings, are attached to the garters.

In order to understand the significance of the clans it is well to remember that Scotland was divided in two parts: the Highlands and the Lowlands. The Highlands comprised the northwest of the country, occupying little over half the area. Formerly the map of Scotland was divided into clans and countries. A clan means a family, or tribe, all loyally under the will of a chief, or chieftain. The Highlands were divided up among 31 clans. Each clan had a dress of distinctive tartan. In some cases a clan had more than one design. The Stuart and Campbell clans and some others had five. In such cases there was a special tartan reserved for the chief. The others wore the dress tartan (in which the plaid appears on a white ground), and the hunting and mourning tartans. Thus while there are but 31 clans in the Highlands there are 96 Highland tartans. Ignorance of this leads to many disputes as to the correctness of a particular tartan, it being generally thought that a clan had but one tartan.

It should be remembered that a «clan tartan» is the specific variety of tartan worn by a Highland clan and to be worn by all members of one family — Campbells, Camerons, Grants, etc. There are certain refinements of distinction; for instance, separate stripes are used to distinguish a chief or two divisions of the same house. Tartan as a distinguishing clan mark seems to be a survival of totemism. It was so arranged that a man could tell to what district as well as to what clan the wearer belonged. There are also two tartans which do not belong to any family; one distinguishes an order, the clergy; and the other, a cause, the Jacobite, or Stuart.

Of the total tartans about one-half are of red ground and one-half are black, blue and green. The Rob Roy is the easiest of all to recognize, as it is a simple red and black check. The Black Watch, or Forty-Second, is black, blue and green. It is often mistaken for the Sutherland, similar in design but lighter in color. The MacMillan is easy to recognize for it is pink, yellow and white; and the very striking and handsome Menzies (pronounced Mingies) is scarlet and white. There are only four tartans with two colors only. The greater number have five colors. Those with black, blue and green ground have stripes, white and red, or yellow and red, or yellow and white. When there are four colors the stripe is white or yellow and red. There are never more than six colors in any tartan, although some of them at first sight appear to have many more. An example is the Ogilvie.

There are three shades of blue and green, but only one shade is used in the same plaid with the exception of the clergy tartan, which has two blues: one is dark and one is light, representing things below and things above. The hunting MacPherson is alone in having gray. Neither violet, nor brown, is employed in tartans, but when blue and red are intermixed in the weaving, they produce a brown effect which is particularly marked in the Erskine, which has but these two colors in equality. The Elliot is the bluest and the MacArthur the greenest of all the tartans.

In Scotland all the big dry-goods houses keep a stock of tartans of all clans, but outside of Scotland they are hard to find. Some London houses keep a complete «set.» The word «set» refers to the size of the design of the tartan and signifies the number of spaces between the colored lines to the width of the tartan from 4 to 24. Thus, a «4-set plaid» has 4; a «16-set,» 16; and a «24-set,» 24. All tartans are made in piece goods and traveling rugs as well as the typically Scotch body wrap, or shawl or «maud,» as it is locally called; it is correctly three and one-half yards long and is used throughout Scotland for mountaineering.

All regular tartans are made so that in the folds of the kilt and plaid, which are made into quilted or box-plaiting, a particular stripe shall appear. Thus, in the Gordon set the stripe is yellow; in the MacKenzie, white; and so on. The plaid over the shoulders is also adjusted carefully so as to exhibit the distinguishing stripe of the family.

One of the most famous tartans is that of the «Black Watch.» This has no clan significance. It is entirely military. When General Wade in 1725 was sent to Scotland to pacify the Highlands, in pursuance of the act for disarming the Highlanders, he gave orders that the six companies in existence should adopt a uniform tartan; and this being of a dark color gave rise to the name of the Black Watch. In 1739 these six companies were formed into a regiment and the history of the Black Watch began. Ever since Fontenoy this regiment has been associated with some of the greatest deeds accomplished by the British army. The great fame of the Black Watch caused other Highland regiments to be formed: the 71st and 72d in 1773; the 74th in 1788; the 78th in 1793; the 79th or Cameron Highlanders in 1795; the 92d or Gordon Highlanders in 1796; and the 93d or Sutherland Highlanders in 1800. The dress of these regiments has become a national feature and has done more than anything else to perpetuate the wearing of the kilt. The Battle of Culloden (1746), where Prince Charles, Edward Stuart, grandson of James II, was defeated by the Duke of Cumberland, ended the clan system.

In that year (1746), the wearing of the tartan was prohibited by the British Parliament under penalty of six months' imprisonment. This act was repealed in 1782, through the efforts of the gallant Duke of Montrose.

In the 36 intervening years the weaving of the Highlanders ceased in the Highlands and many of the old «sets» or patterns were forgotten. Owing to the fact that the tartan was worn in the Lowlands, particularly in Edinburgh, where the ladies made it a fashionable craze, it was possible to revive the ancient fabrics. From 1782 onward the wearing of the tartan became general throughout Scotland, and the romances of Sir Walter Scott, who peopled the country with fascinating heroes and heroines, gave a new and poetic interest to the national dress.

During the World War the Germans called the Highland regiments «Ladies from Hell.»

The king of England and all branches of the royal family wear the royal plaid of the high steward of Scotland, whose name is, in consequence of the office, Stewart (or Stuart). The Prince of Wales, as Lord of the Isles, wears the red and green plaid with intersecting black lines of that district. The Duke of Sussex, who is Earl of Inverness, wears the

Inverness. In modern times many tartans have been invented, manufactured and named after the Border tribes of the Lowlands, such as Douglas, Johnston, Lindsay, etc., and many fancy tartans in various sorts of fabrics have been manufactured, particularly for women's dresses. Silk tartan and tartan velvet (with short nap woven in plaids) have been manufactured for women's dresses and men's waistcoats, and at certain periods have been extremely costly and fashionable. Every sort of article appears in Scotland in the national tartans: capes, skirts, boys' suits, kilts for little boys and girls, underpetticoats, ties, tam o'shanters, blouses, shawls, rugs, kummerbunds and linings for bags and satchels.

The Lowland «Shepherd's Plaid,» or tartan, is a woolen cloth made into small checks of black and white. This is also called a «maud.»

The check and plaid appear in many varieties in the cotton, woolen and silk goods made in India. Agra, for instance, turns out large quantities of checked and striped cotton cloths. Gingham comes from a Malay word, meaning striped. It is of cotton, or linen, woven of dyed threads in stripes or checks and plaids. Ginghams were much worn in the 18th century. For example, the *British Magazine* (1763) notes that «Ladies of taste are prodigiously fond of the ginghams manufactured in Manchester.» *Khes* is the name by which a stout fabric, woven in colored check patterns, is known in the Punjab. The loom for khes weaving is wider than usual and the cloth is prized for winter wraps. Dark red, dark blue and white are the usual colors. These cloths are something like the ginghams and checks of England. They are mostly woven with yarn brought from England, or are Bombay mill-spun. Another kind of check cloth, largely made at Ludhiáná, is called Gabrun or Gamrun. It is still better known as Ludhiáná cloth and is much used by Europeans for summer clothing.

In Multan and Bháwalpur, where variegated silks are produced, checks are among the favorite patterns. In Peshάwar, Kohát, Sháhpur and Bháwalpur silk *Lungis* are made. These are woven of various colors and often with gold thread interwoven for extra beauty. *Lungis* are chiefly worn for turbans and are extensively used on the Punjab frontier, as they are considered handsomer than white turbans. Some of the arrangements of stripes are, like the Scottish tartans, distinctive of certain *Khels*, or clans.

Khes, described above as made of cotton, are also made of silk, sometimes plain, sometimes in patterns. «The *Khes,*» writes Baden-Powell, «is also woven in silk, either check pattern in squares, or plain silk with a gold border and edged with some fancy pattern.»

Blankets of goat's hair are produced in the hill districts of the Punjab. These are often woven into a check pattern. Various kinds of silk and cotton mixed fabrics are made in the Maldah district: Sabzikatár, for example, is of a green ground with fine stripes of checkered crimson and yellow, with figures resembling a dagger between the stripes.

Bulbulchasm has a gold ground with diamond patterns, compared to the eye of the nightingale (bulbul). In many provinces silk and cotton weaving with warps and wefts, which have been separately tied and dyed by the Bandháná knot-tying process, is practised. From this name is derived the *bandanna* handkerchief, which the old Southern negress used to wear in the form of a picturesque turban.

Thus the migration of the check in all its various manifestations and varieties brings mankind together strangely; and the old distinction of plaid and checks, which was used originally to label clans and families, lives to-day as a popular and useful motive of decoration.

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PLAIN (Lat. *planum,* level ground), a tract of land which is level or undulating. That portion of the earth's surface not covered by water may be classified into two great divisions, namely, mountains and plains. This broad classification includes under plains all broad tracts whose surfaces are not so elevated as to be included among mountains. The plains may be classified as the narrow tracts of land, with high land or mountains bordering the sides, as valleys; the broad expanse of level or rolling land of an altitude of 1,000 feet or over, as a plateau, and all the broad plain-lands below 1,000 feet are classified as plains. This classification is not always followed, as many of the plateaus of the world are called great plains. Another method of classification is by the nature of the formation of the plain. The rivers of the world which enter the ocean deposit each year a large amount of débris brought down from the mountains. The ocean currents and tides distribute this deposit over the ocean bed and, in some places, a constant process of plain-building is in progress. As the amount of soil accumulates, the plain grows higher until it becomes a part of the continental land mass. Such tracts of land are called marine plains. The North Atlantic marine plains formed on both the east and west coasts are now so broad that the coast plain on both sides extends far out, below the surface of the water. The fossils found in the strata indicate the origin of the Atlantic Coastal Plain. Tracts of land that were once the beds of great lakes, but which have dried up, are called lacustrine plains. Lacustrine plains exist around Great Salt Lake in Utah, and in Nevada, the valley of the Red River of the North, the vale of Kashmir in northwestern India, and the great Hungarian Plain. The deposit of silt at the mouths of rivers, and sometimes along the banks make fluviatile plains, or flood-plains. The Mississippi, Po, Ganges, Nile and other large rivers have constructed great fluviatile plains, and the mighty builders still continue their work. Still another origin for plains is erosion, by means of which the mountains are lowered and the broad tract of rolling or hilly land forms. Such formations are called plains of denudation. Where considerable of the former mountain area remains, the lowland formed by erosion or denudation is called a peneplain. In respect of fertility plains show all gradations from wholly barren salt plains, such as the salinas of Argentina, in South America, and almost wholly barren deserts, such as are represented chiefly in Africa and Asia, to the highly productive alluvial plains of such great rivers as the Mississippi and the Ganges. Various special kinds of plains in different parts of the world are distinguished by special local names. Among these are the landes, or sandy plains in the southwest of France; the treeless steppes of southern Russia in Europe and Central Asia; the marshy tundras of northern Siberia; the arid karroos of Cape Colony; the savannahs and prairies of North America; the grassy llanos of the Orinoco Valley; the forest plains or selvas of the Amazon basin; and the treeless and partly barren pampas of Argentina. The great desert plain of the world is the Sahara (q.v.) in Africa, extending from the west coast of Africa to the Red Sea, a distance of over 2,500 miles; and over 1,000 miles wide from north to south. This desert plain is made of bare ledges of rock miles in extent, oceans of sand, white in some places on account of the salt. Beyond the Red Sea the desert lands extend, including the Arabian plain, and plains in the interior of Asia, into China almost to the Pacific Ocean. It must not be understood, however, that all deserts are plains; many are highly mountainous. The great plains of the interior of Africa, south of Sahara, are covered with dense vegetation. The interior of Australia, so far as known, consists of extensive low plains upon which the waters of the rivers become stagnant amid gigantic reeds and herbaceous brushwood. The long dry seasons to which the country is subject make the plains vast deserts. The falling of the rains, however, speedily converts these dusty wastes into verdant pastures. Central Asia is a region of immense mountain chains supporting tablelands of great extent. The northern parts of the same continent and of Europe present in a range of more than 6,000 miles a succession of broad plains, covering the greater part of Siberia, a large part of Russia, Germany and Holland. On this range, from the Pacific to the Atlantic, are no elevations exceeding a few hundred feet. These plains in Siberia and Russia are called steppes, and large portions of them are rich pasture lands, without trees, and much resembling the prairies of the Mississippi Valley. The American continent, north and south, is eminently a land of plains. They form full two-thirds of the whole surface of the country, extending on the Atlantic side from one extremity of the continent to the other, with only occasional interruptions by mountain ranges of little extent. In South America are distinguished three great regions of plains separated from each other by low ranges of mountains, which run from the Atlantic Coast toward the Andes. The northern of these regions, having an area of 260,000 square miles, comprises the valley of the Orinoco and its tributaries, and the elevation of this great territory nowhere exceeds 300 feet above the sea-level. So smooth is the surface that over hundreds of square miles the land is almost as unbroken by any unevenness as the water itself, and the rivers are so sluggish that their current is diverted in any direction by light winds. This is the region of the llanos (Lat. *loca plana*). In the dry season the ground is parched and barren, and clouds of fine dust and sand incessantly rising fill the air. The grasses, which in the rainy season suddenly spring up and grow to the height of four feet, are withered and crumble into dust. But as the vegetation appears with the return of the rains, the plains are soon overrun by vast herds of horses and wild cattle, which then find a rich pasturage; and from the jungles of the river banks, to which they had retired during the drought, the great serpents and alligators make their appearance and overspread the plains. The only interruptions to the dead level of the surface, beside the depressions of the beds of the rivers and creeks, appear to be occasional banks of limestone or sandstone, called bancos, standing four or five feet above the general surface, flat at the top, and several leagues in length. Slight undulations, called mesas, imperceptible to the eye, are indicated by the water-courses which are turned by them in different directions. The plains of the Amazon extend up the course of that river and its branches to the Andes, and include, with all the waters they enclose and some ranges of hills, an area of 2,340,000 square miles. About one-third of this territory is covered with dense forests, the principal portions of which have not been explored. So luxuriant is the vegetation and enervating the climate, that to reclaim any considerable extent of these wilds is a task almost beyond the ability of man. From their wooded character the plains here are called selvas; but open tracts like the llanos are scattered among the forests, and numerous broad rivers occupy large areas and afford the only means of gaining access to the distant interior. The plains of the southern portion of South America, lying beyond lat. 15° S., are termed pampas, from an Indian word signifying a flat. They resemble the steppes of Russia, being open grass-covered tracts of vast extent, interspersed with barren areas composed of rocks and sand. Their total extent from north to south is about 1,800 miles, and from east to west from 300 to 900 miles. On the north they reach the region of tropical productions, and at the extreme south their surface is in many places concealed beneath the never-melting ice and snow of those frozen latitudes. Across their range from the coast to the Andes three belts are recognized in their northern division, distinguished from each other by their peculiar productions. The first is strongly marked by its singular growth of tall thistles succeeded by clover. The former come forth with wonderful rapidity in the early summer, shooting up to the height of 10 or 11 feet, and bearing a profusion of rich blossoms. So close are the stems, that even if unarmed with their prickles they would still present an impenetrable barrier. As the summer passes away this vegetation dies down, and luxuriant crops of clover spring up, and invite the return of the countless herds of cattle which were expelled by the thistles. To the west of this is a belt of plains covered with long grass, which from season to season undergoes little change except as the green of summer changes to the brown hue of winter, and this gives place to the verdure of the succeeding spring. Beyond this is a region of more elevated plains lying along the range of the Andes, and covered with low trees and shrubs, all evergreens. The plains of North America, while no less extensive than those of the southern part of the continent, are distinguished from them by greater diversities of level, which, together with the climate, render the country better adapted to the necessities of man. Excepting the parts covered by the Rocky and Alleghany Mountains and their spurs, all the rest are plains uninterrupted by mountain elevations. Near the mountains the surface is hilly and more or less broken, but receding from the Alleghanies westward it gradually assumes the distinctive character of plains, which are developed upon a grand scale in the boundless prairies of the northwest, and in the barren territories commonly known by the name of plains which stretch away from the prairie region in the States of Arkansas, Missouri and Kansas to the foot of the Rocky Mountains. Throughout these immense territories the differences of level are sufficient to produce a steady flow in the mighty rivers, not so rapid as to obstruct their navigation, but sufficient to insure salubrity to the country by a healthy drainage; and thus is secured a system of easy intercommunication between all sections of the country, unsurpassed in importance by any similar system in the world. In the first volume of the geological report of Iowa Prof. James Hall has presented a full account of the northwestern prairies. The region they occupy is the western part of Ohio, nearly the whole of the States of Indiana, Illinois and Iowa, the southern part of Michigan, the northern part of Missouri and portions of Kansas and Nebraska, in which, near the meridians of 97° and 100° W., they gradually pass into the arid and desert plains. Throughout this territory a great sameness exists in the varieties of the topography, the vegetable productions, the soil, and geological features. The surface is drained by streams which commence in almost imperceptible depressions of the high prairies, and flow in beds and valleys of gradually increasing depth between vertical walls of limestone or sandstone, through the horizontal strata of which the current has in past times made its channel. What are called bottom lands lie between the rocky bluffs and the stream, and upon the Mississippi and the Missouri, these attain in places a width of six to eight miles; they are, however, often wanting entirely, the bluffs on each side coming close to the river banks. On the upper Mississippi the bottom lands are in general well wooded, but along the State of Missouri they spread out into open prairies. These low or wet prairies are distinguished from the high or rolling prairies, which form the general upper level of the country upon the summit of the bluffs. The elevation of these above the rivers is very variable. Near Prairie du Chien in Wisconsin, it is about 400 feet above the Mississippi, and the bluffs themselves present a vertical face of about 300 feet. At Cairo in Illinois, the upper surface is from 100 to 250 feet above the river, or 400 to 550 feet above the sea-level. In the central portion of the State, near the Illinois Central Railroad, the average elevation is from 650 to 750 feet above the sea, and near the northern border of the State this increases to 800 or 900 feet, and some of the highest swells of the prairie are 1,000 feet high. In southern Wisconsin the more elevated portions of the prairie are about 1,100 feet above tide water. In Iowa the *plateau du coteau des prairies* of Nicollet, dividing the waters of the Mississippi from those of the Missouri, is from 1,400 to 1,500 feet above the sea. On the head waters of the Illinois and Wabash, and south and west of Lake Michigan, the prairies are very level and smooth, and are termed flat. Elsewhere the surface is undulating and broken by the depressions of the streams, and they are known as rolling prairies. The depressions where there are no streams are often 50 feet below the mean level, and in the bottom the soil is wet and marshy and forms «swales» or «sloughs,» which render the roads almost impassable. In these places the grass grows very rank and tall, but upon the upper and drier surface the natural growth is finer and the sod dense and closely interwoven. A great variety of flowering plants are interspersed among the grasses, and during the summer the whole surface of the prairies is gaily decked with bright colors. The characteristic herbs, as described by Professor Gray in a paper on the «Flora of the Northern States,» published in the ‹American Journal of Science› (2), xxiii, p. 397 (1857), would seem to be compositæ, especially helianthoid compositæ, of many species. Trees are in scattered groups, or along the larger streams, or occasionally on low rocky ridges. West of the Mississippi they become less frequent, and near long. 98° W. they disappear altogether. The soil of the prairies is remarkable for its finely comminuted condition. It is generally free from stones, though in some localities boulders or fragments of rock are found upon the surface and scattered through it. In the swales and in some of the bottom lands the rich black vegetable mold is very deep, but on the upper prairies its depth is usually from one to two feet. The subsoil is almost invariably an argillaceous loam, more or less mixed in its lower portions with sand and occasional pebbles. The total thickness of clay, sand and loam amounts in some places near the larger rivers to 200 feet, but the rock is often found in other places very near the surface. Water is generally found in the sandy stratum 15 to 30 feet below the surface. Throughout the prairie region the underlying rocks are soft sedimentary strata, especially shales and impure limestones. Most of these on exposure disintegrate readily and crumble to soil, and the whole soil of the prairies appears to have been produced from such materials not removed far from their first beds. To the finely comminuted condition of these materials Professor Hall ascribes the treeless character of the prairies. Where such soils are found in portions of the western part of North America, covering tracts of limited area, even enclosed in thickly wooded districts, they are commonly without trees; and as is the case with the vast treeless plains of the Mississippi

Valley, no ancient trunks buried in the soil indicate that the localities were ever covered with trees.

PLAIN, Fort, or **FORT McKEAN,** a former fort of Revolutionary days, located at the junction of the Mohawk and Osquaga creeks, in New York State.

PLAIN SONG (Plain Chant, *Cantus planus,* Gregorian Chant), the most ancient and simple form of church music, consisting of easy progressions in one of the church modes, suitable for use by priests or a congregation. When counterpoint was introduced, it was customary to compose parts above or below a portion of ancient plain song; hence the term plain song is often synonymous with *canto fermo,* or the fixed melody to which counterpoint is added. It differs from modern music, (1) in its recitativo-like character, as opposed to barred music; it has no marked and regular rhythm; the rhythm of a piece of modern music is indicated by the signature as being either in common or in triple time or some variety of these, and the stave is divided into bars or passages equivalent in length; but in plain song there is no such division, and the rhythm of the music is derived from the metrical rhythm of the psalm or hymn rather than vice versa. (2) The *modes* or scales in which plain song is written are more numerous and varied than the modern major and minor. (3) The notation of plain song is by means of a stave of four lines, on any one of which either of the two received clefs (C and F) may be set and so determine the sound of all other notes, above and below. Originally the notes in plain song were all of one length; they are now of three kinds, longs, breves and semibreves, the long being equal to the breve and semibreve. The *modes* of plain song are named after the ancient Greek modes — Dorian, Phrygian, Lydian, etc., but beyond the name there is no relation between the two systems. The principle of the plain song modes is that each of the seven natural sounds of the diatonic scale forms the key-note or «final» of a mode, which comprises that note and the seven above it. (The melodies rarely exceeded an octave, and no flats or sharps are used except an occasional B flat). This gives seven modes; but to each of these is attached another, in which the melody, while having the same «final» or key-note, instead of rising to the octave above, ranges from the fourth below it to the fifth above; these are the *authentic* and the *plagal* modes respectively. The difference between an authentic and a plagal melody may be illustrated from the two psalm tunes *Newton* or *New London* and the *Old Hundredth;* in the first the melody lies between the key-note and its octave, but in the other between the fourth below and the fifth above the key-note. Of these 14 modes two are universally rejected in practice as defective — the 11th and 12th. In the following table the notes of the scale are indicated by the letters of the alphabet according to modern notation; the «final» or key-note in each mode is distinguished by full-face type.

Authentic Modes	Plagal Modes
1. Dorian, **D** E, F, G, A, B, C, D.	2. Hypodorian, A, B, C, **D**, E, F, G, A.
3. Phrygian, **E** F, G, A, B, C, D, E.	4. Hypophrygian, B, C. D, **E**, F, G, A. B.
5. Lydian, **F** G, A, B, C, D, E, F.	6. Hypolydian, C, D, E, **F**, G, A, B, C.
7. Myxolydian, **G** A, B, C. D, E, F, G.	8. Hypomyxolydian, D, E, F, **G** A, B, C, D.
9. Æolian, **A** B, C, D, E, F, G, A.	10. Hypoæolian, E, F, G, **A**, B, C, D, E.
11. Locrian, **B** C, D, E, F, G, A, B.	12. Hypolocrian, F, G, A, **B**, C, D, E, F.
13. Ionian, **C** D, E, F, G, A, B, C.	14. Hypoionian, G, A, B, **C**, D, E, F, G.

The Ionian is the modern major mode. In one or other of the 12 approved modes every plain song melody is composed. The psalm tunes are written in the eight modes one, three, five and seven (authentic), and two, four, six and eight (plagal); the 114th psalm, *In Exitu Israel,* has from ancient times been sung to a peculiarly beautiful melody in mode nine, the *Tonus peregrinus:* ancient tradition traces this tune back to the time of the Maccabees and the purification of the Temple after the first victories of Judas Maccabæus (165 B.C.) on which occasion were sung the psalms of the Hallel (Ps. cxiii-cxviii); and it is highly probable that all the psalm tones used by the church had their origin in the Jewish Temple-service. From the beginning vocal music was employed in the church service and formed an important part of it. At first the tones and melodies were handed down orally, afterward some crude system of notation was devised, but it was defective, and was reformed by Saint Ambrose, bishop of Milan (4th century), who brought to the West the mode of chanting which he had learned during his residence at Antioch: the 'Ambrosian chant' was founded on the first four authentic modes, and was sung antiphonally. Till the pontificate of Gregory I it was widely in use in the Western churches; but after Gregory's reform the Ambrosian chant was disused, and is now practised only in the cathedral and diocese of Milan. How Gregory noted the music is uncertain; the early notation and rules of plain song were so complicated that it is said 10 years' study was necessary to acquire mastery of them. Among the plain song melodies used in the Roman church service of the Holy Week, those of the Lamentations of Jeremiah and of the *Exultet,* a portion of the Holy Saturday service, are by musicians declared to be «beautiful beyond all description»; and the *Exultet* has been regarded as the finest example of plain song in existence.

PLAIN TALES FROM THE HILLS, Rudyard Kipling's first book, originally published in Calcutta in 1888, quickly drew the attention of European and American critics to «this cocksure young man from India» who was opening our eyes to a new world. These stories, with their breezy, individual style and unusual plots, portraying Anglo-Indians in social, official and military life and giving a few glimpses of mysterious native ways, soon established the young Anglo-Indian journalist in the minds of Western readers as the literary discoverer of modern Hindustan. As Andrew Lang wrote of the author, «For the first time he has shown English readers what India is like; how full of infinitely various life and romance.» Many of the tales, as less favorable critics have remarked, are somewhat marred by youthful cynicism and a method that is rather too journalistic; and it has been objected that they unfairly emphasize the less pleasing features of Anglo-Indian society; yet their interest is unfailing, and they are full of the promise so amply fulfilled in the author's maturer work. In the later authorized editions, the collection consists of 38 stories, among them 'Lispeth,' the story of a Himalayan Hill-girl: 'Three and an Extra,' introducing Kipling's social heroine, Mrs. Hauksbee; 'Miss Youghal's Sais,' being the romance of the author's favorite secret service officer, the redoubtable Strickland; 'Thrown Away,' the pathetic story of a young subaltern, and such vignettes of native life as 'In the House of Suddhoo,' 'Beyond the Pale,' 'The Gate of a Hundred Sorrows' and that tender little tale of a brown baby, 'The Story of Muhammad Din.'

ARTHUR GUITERMAN.

PLAINFIELD, Conn., town in Windham County, on Moosup River (a tributary of the Thames), and on the New York, New Haven and Hartford Railroad, about 41 miles east of Hartford. The town includes within its corporate limits several villages. It was settled in 1690 and at first was called Quinebeag. It was incorporated as a town in 1699. The chief manufacturing establishments are a foundry, wagon and carriage shops, cotton and woolen mills, thread and yarn factories, and creameries. The old Plainfield Academy is in the village of Plainfield, and there are public libraries in the villages of Plainfield and Moosup. The government is by annual town meetings. Pop. 6,719.

PLAINFIELD, N. J., city in Union County, on the Central of New Jersey Railroad, about 15 miles west by south of Newark and 24 miles west of New York City. It is at the base of First Mountain, a ridge or uplift in the northeastern part of the State. It was first settled in 1684, incorporated as a township in 1847, and chartered as a city in 1869. It is a residential city, but it has a number of manufacturing establishments, chief of which are machine shops, wagon and carriage factories, æroplane works, silk and cotton mills, kid glove factories, lumber mills, furniture factories and aluminum works. Chamois, men's clothing and printing-presses are also manufactured here. The notable public institutions are the Muhlenberg Hospital, 25 churches, eight public schools, one parish school, several private schools, a public library which has about 30,000 volumes, and the Young Men's Christian Association building. The three banks and one trust company have a combined capital of over $500,000, exclusive of the savings bank. The government is vested in a mayor and a council of 11 members who appoint or elect the administrative officials. Pop. 24,516.

PLAINS OF ABRAHAM. An elevated tableland above Quebec, on the west and southwest boundaries of the city. It was named after Abraham Martin, one of the pioneers of French Canada. It formed the scene of the famous battle between French and English which determined the mastery of the New World, when the British forces, under James Wolfe (q.v.), defeated the French under Montcalm (q.v.). Both leaders were mortally wounded in the engagement; the spot where Wolfe died is marked by a monument and not far distant is another, erected to the joint memory of Montcalm and Wolfe. The ground now commonly known as the Plains of Abraham, which was purchased by the government and given to the city of Quebec in 1908, and called the Park of the Battlefields, formed no part of the scene of the famous conflict, nor was any portion of this ground ever owned by Abraham Martin.

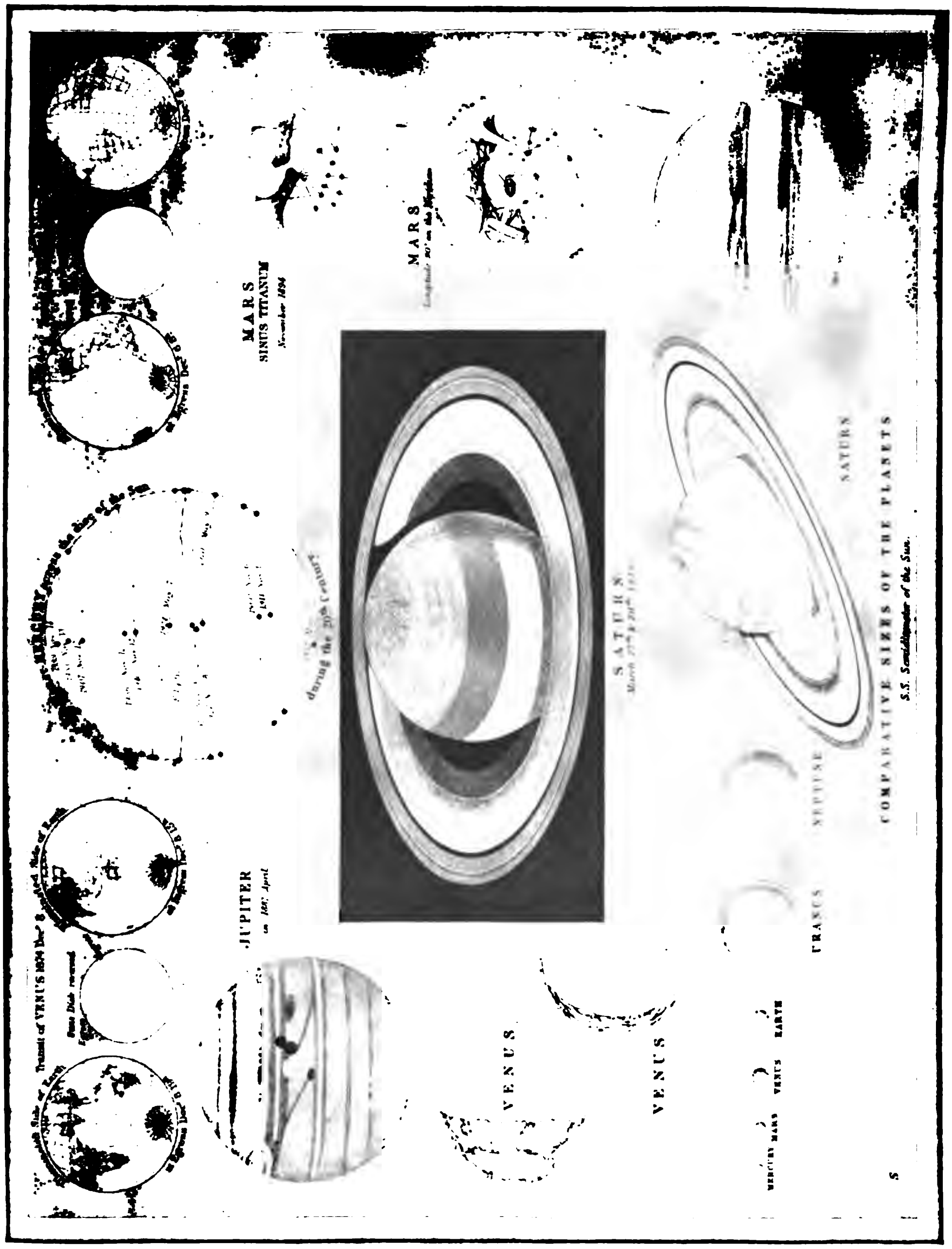
PLAINVIEW, Tex., town and county-seat of Hale County, on the Panhandle and Santa Fé Railroad, 315 miles northeast of Dallas. The Wayland Baptist College and the Seth Ward Methodist College are situated in Plainview, which contains also a Masonic Hall, an Elks Home, sanitarium, city hall and courthouse. The town has extensive farming, stock-raising and fruit-growing interests. The town owns the water-supply system. Pop. 2,829.

PLAINVILLE, Conn., town in Hartford County, about five miles northwest of New Britain, on the New York, New Haven and Hartford Railroad. Electrical supply works constitute the bulk of the town's industrial activity. Pop. 2,882.

PLANARIAN WORMS. The term is usually employed to designate free living flatworms included under the *Turbellaria.* They are distinguished by the presence of a triclad or polyclad alimentary canal. The fresh-water forms (triclads) are abundant in ponds or streams, where they occur on stones, sticks and water plants. The soft body is elongate and moves in a gliding manner by the action of the ciliary coating of the epidermis. Marine planarians (polyclads) are broader, leaf-like and much larger. Land planarians are rare beyond the tropics and sub-tropics, where they occur abundantly in moist regions and are photophobic in habit. In form they are much elongated, cylindrical and of considerable size, while the body is often brilliantly marked by colored bands. The food usually consists of higher worms, mollusks and insects, although a few have become true parasites. Consult Graff, 'Monographie der Turbellarien' (Leipzig 1882–99); Woodward, 'Bulletin Harvard Museum' (XXXI, 1898).

PLANCHETTE, plăn-chĕt' (Fr. plăñ-shĕt), a thin heart-shaped piece of wood supported on two castors at the ends of the base and on an ordinary pencil at the apex that was popular about 1860 to 1880, before the Ouija board supplanted it. If the finger-tips be placed upon this device, the pencil may readily be made to trace characters without conscious movement on the part of the operator. Like the Ouija board it was used by two classes of persons: (1) Believers in Spiritualism, who asked questions of a spiritual control and believed that they received answers from intelligences on the spirit plane; and (2) people who regarded the mechanism as a game and amused themselves by pushing it to write messages for the benefit of others present. When used by some persons the planchette seemed to begin to move of its own accord after a little space of time and if the person wished, for instance, to have an answer to a certain question, writing was formed on the sheet of paper on which the instrument was placed, containing something

PLANETS



Comparative Sizes of the Planets

more or less pertinent to the matter. Consult Huntley, F., 'The Great Psychological Crime' (Chicago 1912).

PLANÇON, plän-sôn, **Pol**, French bass singer: b. in the Ardennes, France, about 1855; d. 1914. He studied music at the École Duprez in Paris and in 1881 made his début at Lyons in 'Les Huguenots.' In 1883 he appeared in the Paris Grand Opéra as Mephisto in 'Faust' and scored a great success, which was followed by an equally praiseworthy presentation of Ramfis in 'Aïda.' He has been warmly received at the Metropolitan Opera House in New York. He has created roles in Saint-Saëns' 'Ascanion'; Massenet's 'Le Cid', etc.

PLANCUS, Lucius Munatius, Roman politician and soldier: b. Tibur, near Rome, 1st century B.C. He was a pupil of Cicero and an officer under Cæsar in the Gallic war and was shown much favor by that general. After Cæsar's assassination he favored Brutus, but soon deserted to Antony and in 42 B.C. was consul. Later he fell in disfavor with Antony and became a partisan of Octavius. The 7th ode of the first book of Horace is dedicated to him.

PLANE, a popular name for several trees of the genus *Plantanus*, which alone constitutes the family *Platanaceæ*, which includes six or seven species, all natives of the northern hemisphere. The American plane, sycamore, buttonwood, or buttonball (*Platanus occidentalis*), the largest tree of eastern North America, often attains heights of 130 feet and occasionally more than 150 feet. The diameter is frequently more than eight feet. It is a native from Maine to Minnesota and southward to the Gulf States and is a familiar object in low grounds along streams, especially in the Middle States. Its brownish timber is sometimes used for interior finish and frequently for fuel. The California sycamore (*P. racemosa*) and the Arizona sycamore (*P. wrightii*) are smaller than the eastern, which they resemble more or less. They are confined to the southwestern States. The name «plane» is often applied to the sycamore maple or great maple (*Acer pseudoplatanus*) because of the resemblance of the foliage to that of the true plane tree.

The Oriental plane is *P. orientalis*, a native of India, southwestern Asia and southeastern Europe. It grows about 80 feet tall, has a rather short, thick trunk and a broad round head; grayish or greenish bark which annually flakes off; large, palmate, deciduous leaves; and monœcious flowers crowded in globular heads, pendulous on long stalks. The bristly fruit-heads persist during the winter. The tree was popularly planted by the Greeks and Romans as an ornament and specimens are still extant which are reputed to be more than 2,000 years old. It thrives best in moist, rich alluvial soil. The timber of young trees is cream-colored; that of old trees brownish. Being fine-grained and easily polished it is popular for cabinet making and for interior finishing.

PLANE, a flat, level surface; *in geometry*, a surface characterized by the property that the straight line joining any two points in it lies wholly in the surface; a level surface. Two such surfaces cannot have three points, not in a straight line, in common without coinciding throughout and any two planes intersect in a straight line. Parallel planes are those whose line of intersection is at an infinite distance, or such as can have a common normal or perpendicular. The angle between two non-parallel planes is that formed by two intersecting straight lines, one in either plane, perpendicular to the line of intersection. There will always be two such angles, each being the supplement of the other, but in ordinary cases the acute one will be most naturally regarded as the angle formed by the planes. One plane is perpendicular to another when the angles thus formed are right angles, or, to put the same thing in a simpler way, when it contains a straight line perpendicular to that other. Three planes will always have one point in common, but this point may be infinitely removed; and they form a solid angle, which is measured in a special way. three mutually perpendicular planes, known as the co-ordinate planes, are used in analytical geometry of three dimensions for determining the position of points in space. See GEOMETRY.

PLANE. See METAL-WORKING MACHINERY; WOOD-WORKING MACHINERY.

PLANE CURVES. See CURVES, HIGHER PLANE.

PLANE-TABLE SURVEYING. See SURVEYING.

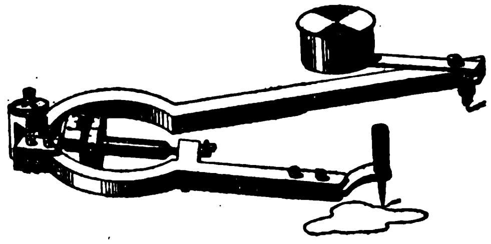
PLANET, any world which, revolving about a far larger, central sun, shines principally by light reflected from this sun. Of the eight planets of the solar system, the four inner are solid and the four outer are probably in a gaseous condition and are probably slightly self-luminous. (See EARTH; JUPITER; MARS; MERCURY; NEPTUNE; SATURN; URANUS and VENUS). For such evidence as we have as to the existence of other systems of planets, see COSMOGONY.

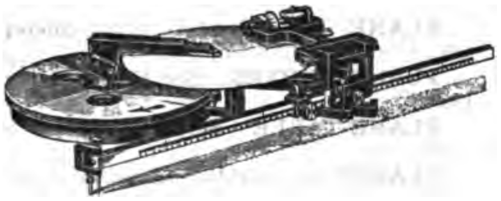
PLANETARIUM. See ORRERY.

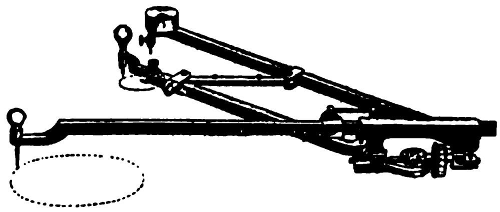
PLANETESIMAL HYPOTHESIS. See COSMOGONY; GEOLOGY.

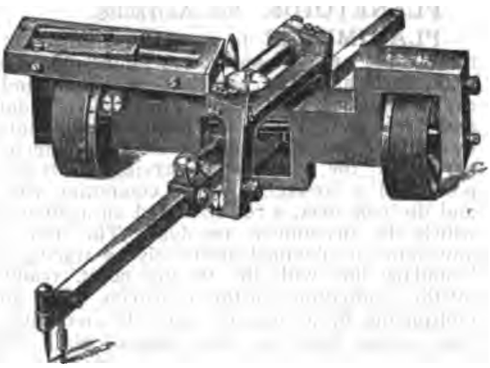
PLANETOIDS. See ASTEROIDS.

PLANIMETER is a machine for determining the area of any plane figure drawn to scale such as maps, sections, diagrams, indicator diagrams. There are two kinds, «polar» and «rolling.» The polar planimeter invented by Amsler in 1850 consists of two principal parts, viz., the *tracer arm* carrying the tracing point and a carriage with the computing wheel and the *pole arm*, a rod mounted on a pivot on which the instrument revolves. The area of any figure is obtained accurately by tracing its boundary line with the tracing point, reading off the graduations on the measuring wheel and multiplying by a suitable factor to give square feet, square miles or other desired unit. The original instrument has been considerably improved as to usefulness and accuracy and in being set to any desired scale, but as all polar planimeters revolve around a fixed point, their scope is limited by the length of arms of the instrument. Therefore, a large figure has to be divided into sections. The *rolling* planimeter moves on two broad rollers from one of which the movement is imparted to the recording mechanism. The measuring wheel revolves by contact with a polished sphere segment. Only the rollers and the tracer are in contact with the drawing and the results are, therefore, not affected by irregularity of the paper. Accordingly it will measure with one operation the area of a figure of any length, the width of which does not exceed the length of the extended tracer-arm. Wider areas can be subdivided by lines and each subdivision measured separately. Figure 1 shows the simplest form of polar planimeter. A higher grade machine is shown in figure 2. *The compensating planimeter* is a modification of the polar instrument in which the pole arm is held in the wheel carriage of the tracer arm by a pivot which ends in a steel ball fitting nicely in a socket of the wheel carriage. This gives rigidity and the tracer arm has an angular motion of 180 degrees, or much greater than in old forms. By measuring a figure with pole on the left and then again with pole on the right side of the tracer arm and taking the mean the instrumental errors are compensated. *The pantograph polar planimeter* has two arms, one about seven and one-half inches long for measuring very small figures and one 11 inches long which covers a circle 38 inches in diameter for measuring large figures. The machine is so compensated that when the smaller arm is used the result is more accurate. *The disc planimeter* is another form in which the motion of the measuring wheel is independent of the condition of the paper on which the figure is drawn as the measuring wheel revolves by contact with the plane disc.


Polar Planimeter.


Precision Polar Disc planimeter.


Pantograph Polar Planimeter.


Precision Rolling Planimeter.

For mechanical integrators or integraphs which work on nearly the same principle as the planimeter see INTEGRATORS.

PLANING MACHINE. See METAL-WORKING MACHINERY; WOOD-WORKING MACHINERY.

PLANK, Fort, or FORT BLANK, a former fort, of Revolutionary days, located in Montgomery County, N. Y., about two miles northwest from the village of Fort Plain.

PLANKINTON, S. Dak., city, county-seat of Aurora County, on the Chicago, Milwaukee and Saint Paul Railroad, about 80 miles northwest of Yankton. It is in an agricultural and stock-raising centre, has grain elevators and mills and ships considerable wheat. There are two newspapers and a bank. Pop. 916.

PLANKTON, a term given by Haeckel to the life, both animal and plant, which occurs floating at the top of lakes and seas, in contrast to the forms of the shores or bottoms. The vegetable element in the plankton is largely diatoms while the animals show a much greater variety. In the fresh waters the plankton is very inconsiderable as compared with that of the sea and to the latter most of these statements apply. The marine plankton consists of both young and adult animals. The adults are largely protozoans, jellyfish, tunisates (especially *Salpa, Doliolum, Pyrosoma, Appendicularia*), together with a few worms. The young include representatives of almost every group of marine animals for the larvæ of many shore or bottom animals are free-swimming for a time. One marked feature of these surface forms is their great transparency and almost total absence of color, except the black pigment in the eyes of the eyed forms.

The plant life of the oceanic plankton includes diatoms, bacteria, blue-green algæ and similar low organisms. The first are especially conspicuous in very cold waters. In some cases the prevailing organism is so abundant that the water is distinctly tinted by it, as in the Red Sea, where a red alga is especially numerous. Many of the plants have powers of locomotion well developed, a feature peculiar to low forms of plant life. The fresh-water vegetable planktons are less noteworthy than the marine because of their smaller extent, the much smaller number of species generally represented, etc. These formations are of particular interest from an economic point of view because they constitute the pastures of the deep. The minute animals feed more or less upon the plant life, great numbers of free-swimming, surface-inhabiting marine animals feed upon the plants or the animals or both, and are in turn the food of other pelagic animals or birds. At certain seasons the leading forms of the plankton disappear and others take their places. Generally they sink to lower levels to reappear after a more or less definite time. To the student of zoology the plankton is of great interest both from its importance as a food supply for marine forms and as a means of obtaining the larvæ of many animals. It is studied by collecting the life in a net of bolting cloth drawn along the surface and then examining the catch with the microscope. The plankton varies greatly from day to day, and is markedly more abundant at night than in the day. Many of the forms, notably the medusæ, worms and young crustacea, are markedly phosphorescent and to them is due the light in a vessel's wake.

PLANQUETTE, plän-kĕt, **Robert**, French composer: b. Paris, 21 July 1850; d. there, 28 Jan. 1903. He studied at the Conservatoire and with Duprato, gained some popularity by numerous chansons and chansonettes, in 1873 began the writing of operettas and in 1877 achieved a notable success with ‹Les Cloches de Corneville,› which ran for 400 performances in Paris, and later as ‹The Chimes of Normandy› was almost equally popular in London. It has been often heard in both the French and English versions in the United States. Planquette did not attempt any more serious form of music, but wrote 18 other operettas, including two, ‹The Old Guard› (1887) and ‹Paul Jones› (1889) for the English stage.

PLANT, Morton F., American financier: b. New Haven, Conn., 18 Aug. 1852. He was educated at Russell's Military School, New Haven, and began his business career, in 1868, in the service of the Southern Express Company at Memphis, Tenn. From 1884 he was connected with the Plant system of railroads, of which he was vice-president until 1902, when the system was merged in the Atlantic Coast Line Railroad Company. Mr. Plant is a director of the Atlantic Coast Line and vice-president of the Chicago, Indianapolis and Louisville Railway and chairman of the board of directors of the Southern Express Company. He is a director of the National Bank of Commerce and trustee of the Connecticut Trust and Safe Deposit Company.

PLANT, in its most general sense, one of the vegetable order of organized things, possessed of life, but not of feeling; in more restricted and popular usage, any small herb, thus excluding the larger shrubs and trees. Originally the term denoted a short, cutting or sapling, as shown by its derivation from the Greek πλατύς, broad, Latin *Planus*, flat. In modern times the term has come to denote the building, machinery, fixtures, etc., necessary for the operation of an industry or business, and in a colloquial sense, also denotes a plot or swindle. In this work plants in the botanical sense are treated under Alpine Plants; Beach Plants; Plants, Breeding of; Plants, Classification of; Plants, Diseases of; Embryology of Plants; Fertilization in Plants; Plant Foods; Plant Geography; Plants, Malformations in; Plants, Migration of; Plants, Morphological Evolution of; Plants, Ornamental; Plants, Physiology of; Plants, Poisonous; Plants, Recapitulation in; Plants, Vascular Anatomy of. See also Agricultural Chemistry.

PLANT-BUG, a bug of any of several families of *Hemiptera*, which obtain their food by sucking the juices of plants through beak-like mouths. The largest group is the family *Coreidæ*, consisting of at least 1,500 species, some of which are dreaded pests of cultivated crops and trees. Two well-known species are the box-elder plant-bug (*Leptocoris trivittatus*), which is especially troublesome in the western States, where the box-elder is largely planted as a windbreak and for timber: and the squash-bug (*Anasa tristis*), which is an incorrigible enemy of squashes, pumpkins, cucumbers, etc. (See Squash). The *Lygæidæ* include fully 1,300 species, nearly 200 of which are known in America, and of which one of the most widely destructive is the little chinch-bug, a pest upon certain cereal crops. The *Pyrrhocoridæ* is a small family, but contains several serious pests, of which the cotton stainer or red-bug (*Dysdurcas suturellus*) is a pest in the southeastern United States. It feeds upon orange fruits and cotton. Consult Comstock, ‹Manual for the Study of Insects› (1895); Smith, ‹Manual of Economic Entomology› (1896); Howard, ‹The Insect Book› (new ed., 1914).

PLANT GEOGRAPHY.— The relation of the plant covering to the surface of the earth is the basis of that division of botany which is called plant geography. This does not confine itself to the geographical distribution of plants, as was formerly the case, but comprises all the out-of-door relations of plants to each other, and to their environment. The subject falls somewhat naturally into several divisions with respect to the point of view. Floristic botany deals with the geographical distribution of species, and with the character of the plant population of different regions and countries. Ecology concerns itself especially with the relation existing between the plant and its environment, and with the grouping of species in particular areas called formations, such as prairie, forest, etc. Experimental ecology is merely a phase of the latter, in which changes in the form and behavior of plants are brought about by changing the physical conditions of the environment. It is of great importance because of its bearing upon the origin of species.

Environment and Plant.— The essential points of inquiry in plant geography are the environment, or home of the plant, usually called habitat by botanists, and the plant, either as an individual, or as a member of the vegetation. The habitat is to be regarded as the cause, the plant as the effect. This is true of the present relation between any habitat and the plants which grow in it only to a certain degree, for probably no plant of the present day owes its entire structure to one habitat. Each habitat, however, does have a modifying influence upon the plants in it. This influence will be great where the physical conditions are extreme, and it will be slight where they are more moderate. In either case this modification will leave its distinctive stamp upon the plant in such a way that one may readily tell whether it grew in pond, meadow, forest or desert. Of the many factors which make up a habitat not all are of the same importance. In some situations the water of the soil will be most important, in others light will be the controlling factor, while in still other places wind will have the most striking effect. Habitats show great differences also in the amount of water, light, wind and other factors. If one will know the causes of plant structure and distribution, it is necessary to look into the habitat with great care, and to determine the relative importance and the amount of each factor.

The factors of a habitat which are most intimately connected with the form of the plant are those that have to do with the water-supply, and with the food-making activities of the leaf. These are water and light. They have a direct influence upon the plant form, while all others affect the structure indirectly, as a result of their action upon the water of the soil, or the air, or upon light. Every habitat comprises the following factors: water-content, humidity, light, temperature, soil, wind, precipitation, physiography, dead vegetation and animals. Of these, water-content, soil, soil temperature, and physiography belong to the soil, and are in consequence called edaphic. Humidity (air moisture), light, air temperature, wind, and precipitation pertain to the air, and are termed atmospheric or climatic. Dead vegetation and animals are biological or biotic factors. Living vegetation has a marked effect upon its habitat, but this is to be regarded more as a reaction than as a cause.

Water as a Factor.— The simplest plants grow in water, and are in every way dependent upon it. Terrestrial plants — for example, practically all flowering plants and ferns — have adapted themselves to two media, air and water, and their dependence upon water is not so marked. The active root-hairs are still really aquatic, and must always be in contact with an adequate supply of water. The stems and leaves are aerial, but their behavior and form are largely determined by the water in the air, that is, the humidity. The water-supply is used by the root-hairs, while water-loss is the result of evaporation from the surface of the leaves. The excess of supply over loss will determine the form of the plant; it is evident that plants cannot grow where the loss exceeds the supply. The balance between these is so nice that plants grow well only where it is maintained. The most luxuriant vegetation is the forest, where both supply and loss of water are great. An excess of supply over loss is almost as certain to produce stunting and dwarfing, as seen in the plants of ponds and marshes, as is an excessive water-loss, which is the condition typical of deserts and high mountain peaks. The total amount of water present in the soil will vary with the rainfall, and with the behavior of surface and underground streams. Much of the rainfall runs off the surface, while a part of it sinks below the roots and is carried off by underground drainage. What is left remains in contact with the soil-particles as a thin film, and it is this which is absorbed by the root-hairs. The pull exerted by the absorptive power of the hair upon the water-film is greater than the attraction of the soil-particle, and the latter loses its water. If this continues, however, the ratio lessens, and in soils that are drying out the particles hold the water-films with increasing tenacity. In consequence, plants will wilt and die in soils that still contain water. Loose soils, such as sand and gravel, will give up all but 0.5 to 1 per cent of the water-content, while compact clays retain as high as 12 to 30 per cent. An excess of salts in the soil, or a lack of air usually produces a similar effect. They decrease the absorptive power of the root-hairs, and lead to the production in marshes and bogs of plants showing the effects of an insufficient water-supply.

Air Humidity.— The humidity of the air exerts a direct control upon the amount of water evaporated from the leaves. It is evident that the water-loss of the plant will be slight where the amount of moisture in the air is great, and that the evaporation will be great where the air is dry. This effect of humidity is so marked that plants which grow in moist climates often have structures designed to increase water-loss, while those living in desert-like places regularly protect themselves by thickening their epidermis, and decreasing the amount of surface exposed. The relative humidity of lowlands and seacoasts, especially in the tropics, is above 80 per cent; in deserts and upon high mountains it is rarely more than 30 per cent, and often falls below 15 per cent.

Influence of Light.— The amount of light present in a habitat influences directly the food-making activities of the plant. The green coloring matter of plants, the chlorophyll, is formed readily and abundantly only in the light, and the combination of crude materials, water, carbon dioxide, and salts into foods available for the protoplasm can occur only in the presence of this pigment. Light thus bears a peculiar relation to the nutrition and growth of plants, and in a large degree determines their form and size. Sunlight produces vigorous, stocky stems, and thick leaves, as a rule, while plants grown in the shade have tall slender stems, and broad thin leaves. Plants that occur underground, in caves, or grow within organisms, do not develop chlorophyll, and without exception belong to the flowerless forms known as fungi. The intensity of the light varies throughout the day and year; it is greater in the tropics than at the poles, and on the tops of high peaks than at their bases. In forests and thickets the light is often very diffuse, varying from .01 to .003, summer sunlight being 1.

Temperature.— This is directly concerned with the nutrition and growth of plants. Heat is necessary for the germination of seeds, and for the sprouting of bulbs and tubers. It must be present in a considerable degree for the food-making activities of plants, and upon it in a large part depends the size of individuals, and the luxuriance of vegetation. The growing period is the season during which temperatures favorable to plant growth prevail; the length of this period determines in great measure the native vegetation of a country, and the cultivated plants which can be grown there. Indirectly, temperature exerts a pronounced effect upon the form of plants, by decreasing the moisture of the air, and thus increasing the water-loss. In tropical and subtropical deserts this indirect action of heat is a predominant factor. Soil temperatures are of much less importance, though they have much to do with germination and the activity of underground parts.

Wind Effects.— Wind influences plant life both directly and indirectly. Its mechanical action is marked in regions where forceful and constant winds prevail, notably seacoasts and high mountain peaks. Shrubs and trees become bent or prostrate, and their branches are developed almost wholly on the leeward side. Over great open stretches where strong winds prevail, for example prairies and steppes, the plant forms are largely grasses and grass-like plants, which are not easily torn or whipped by the wind. As is well-known, winds play an extremely important part in carrying the pollen of trees and grasses, and in scattering seeds and spores. Like heat, wind decreases the humidity of the air, and correspondingly increases the evaporation from leaf-surfaces. It does this by removing the more or less saturated air in contact with the plant, replacing it with air containing less moisture. This action is characteristic of the dry southwest winds in the corn-belt, which rapidly carry away the moisture of the leaves, causing the latter to curl, thus decreasing the surface and affording some measure of protection. The stunted forest vegetation of arctic and alpine timber-lines is largely due to the drying action of almost constant winds. The direction, force, and duration of the wind must all be taken into account in the study of vegetation.

Soil Action.— The soil acts directly upon the behavior and form of plants by reason of its influence upon water-content and temperature. In plant geography, all inorganic strata upon which plants grow are termed soils. The extreme types are rock and water, between which are found all manner of gradations from gravel to mud. The weathering of rocks produces two kinds of soils quite different in their behavior with respect to water. The one is loose and composed of large particles — for example, sands and gravels; the other is composed of fine, compact particles, clays and loams. Sands and gravels absorb nearly all of the rain falling upon them but much of the water taken up passes through and is carried away along some impervious stratum. What remains as water-content is readily absorbed by the root-hairs or is lost by evaporation from the soil. On account of the large air-spaces between the grains, the water in the lower layers is raised with difficulty by capillary action. Plants withdraw from loose soils nearly all of their water-content. Compact soils, especially clay do not absorb rain rapidly, and much of the latter is carried away by surface drainage. Water once absorbed is held tenaciously, and the loss by underground drainage is slight. The pores of the soil are fine, and capillarity plays an important part in raising water from the lower levels. The particles attract the water-films strongly, and in consequence clay yields its water to plant or air very slowly. Ordinary plants will wilt in clay soils which still contain as high as 12 to 30 per cent of water. Rock is all but absolutely impervious to water. Mosses and lichens alone can grow upon it, in consequence of their power to decompose the surface and their ability to withstand drying out. The amount of soluble material in the soil has a direct effect upon the growth of plants. Nearly all ordinary soils contain an adequate supply of soluble minerals; a few, however, are deficient in these, and are unable to support more than a scanty vegetation. Other soils contain in excess soluble salts and acids which are harmful. The sparse, desert-like vegetation of salt basins and alkali wastes is due to the large quantities of sodium chloride, sodium carbonate, and other salts present. In swamps and bogs the decay of plant and animal remains uses up the available oxygen and thus hinders the absorptive powers of the roots. The kind of material in the soil and the fineness and compactness of the grains determine its behavior with reference to the absorption and radiation of heat. The color of the soil, the amount of water present, and other conditions have also to do with this matter. Rock is warmed most readily in the sunshine, and at night most readily parts with its heat. Water is at the other extreme; it warms up slowly and, conversely, yields its heat reluctantly.

Utilization of Moisture.— It is a well-established fact that plants in general are unable to absorb water-vapor from the air. The moisture must be condensed into water, and then must regularly find its way into the soil before it can be used by the plant. A comparatively small number of plants, lichens, mosses, and tree-dwelling orchids absorb rain or dew directly through their leaf or thallus surfaces, but with the great majority of plants the water can only be taken in from the soil or substratum. The moisture of the air is condensed or precipitated in various forms — rain, dew, snow, sleet, hail, frost and fog. With the exception of the last, all of these contribute sooner or later to the water-content of the soil, the important difference being that the solid forms usually melt gradually and are in consequence absorbed more completely. The water which falls upon the surface of the soil is partly absorbed, and partly carried away by drainage. The latter is known as «run-off»; its amount will depend upon the compactness of the soil and the steepness of the slope. The absorbed water passes into the lower layers in part, where some of it is drained off as gravitation water, and some is retained as capillary water to be raised by pillary action into the upper layers of the soil. That which remains in the soil about the roots forms thin films about the soil-grains, and is known as the water-content. This alone can be used by the root-hairs. Part of it, however, is lost by direct evaporation from the soil. Rain has little or no mechanical action upon plants, except perhaps in the tropics, where it falls in torrents. In the form of «run-off,» however, it acts powerfully upon the surface of hills and mountains, and plays in consequence an extremely important part in the development of vegetation. Sleet and hail are very destructive in the breaking of twigs and branches and the cutting and tearing of leaves, but are of little importance because of their relative infrequence. Snow, on the other hand, has had a great deal to do with the forms of trees, particularly the pines, spruces, and firs, in northern and mountain regions. It is a poor conductor, and for this reason affords much protection to plant parts covered by it. Unlike rain, it is often unequally distributed by the wind, and therefore produces important local differences in the water-content of the soil.

Physiography.— The surface features of a region — its physiography — affect directly several of the physical factors of habitats. Altitude not only influences the rainfall, but it also increases water-loss by reason of the reduced air-pressure and the decreased humidity. The sunlight may be stronger, as the rays pass through fewer air-layers, and are absorbed in a less degree. The degree of slope is especially important, as it determines very largely the ratio between «run-off» and absorbed water. In mountain regions particularly, it modifies the angle at which the sun's rays strike the surface, and increases the amount of heat and light received. The exposure of the surface, that is, the direction in which it lies, affects the amount of heat and light, the intensity of the wind, and the snowfall. Furthermore, the character of the surface itself, whether level or uneven, will influence all of these factors in a less degree. Physiographic changes, such as elevation and subsidence, the erosion of river-valleys, and the upbuilding of swamps, deltas, etc., have a profound effect upon the distribution of plants, and the development of vegetation.

Vegetable, Animal and Human Factors.— Dead vegetation increases the water-content of a habitat by checking the movement of the «run-off,» and thus increasing the absorption, and by protecting the surface of the soil from excessive evaporation. It equalizes the soil temperature by hindering the warming action of the sun's rays, and the cooling effect of radiation. It also diminishes the force of the wind, and, finally, by decay, returns to the soil much of the nutrient material taken from it. Living vegetation has the same effect, but is different in that it constantly draws water and nourishment from the soil, and often reduces the amount of light present. The activities of animals and man are extremely diverse. Earthworms and burrowing mammals enrich the soil by working it over repeatedly. Grazing animals have more or less effect upon grasslands. Insects are fundamentally important in fertilization, and doubtless often act decisively in the struggle for existence by destroying some plants and not others. Man is a biological factor of the first importance, even if we leave out of consideration all the changes that he has brought about in plants and vegetation in consequence of cultivation. He changes habitats fundamentally by the removal of forests, by fires, by the construction of railroads and canals, by drainage, by irrigation, etc.

Classification of Habitats.— Habitats are usually grouped with respect to the two direct factors, water and light. They are first classed as wet, moist and dry and the moist habitats are further divided into sun and shade. Wet habitats comprise all bodies of water, oceans, lakes, ponds, springs, streams, swamps, marshes, river-banks, seashores, tanks, etc. Dry habitats are principally deserts, sandhills, prairies, gravel-slides, strands, dunes, bad lands, cliffs, rocks, heaths, humus-marshes, moors, alpine and polar barrens. Sunny moist lands are meadows, pastures, grain-fields and waste places. Shady moist habitats are forests, groves, woodlands and thickets.

Effects of Habitat.— These, as regards the individual, are either evident or demonstrable, as in the case of the habitat form seen in bog-plants, shade-plants, etc., or they are obscure and remote and can in consequence no longer be traced. The latter is true of vegetation forms — trees, shrubs, bulb-plants, etc. Three well-defined groups of habitat forms are recognized, based upon the water-content of habitats. These are water-plants (hydrophytes), moist-land or middle plants (mesophytes), and desert plants (xerophytes). Upon the basis of light differences, mesophytes are further divided into sun-plants (heliophytes), shade-plants (sciophytes) and darkness-plants (scotophytes). Water plants owe their peculiar stamp to the fact that the water-supply is always greatly in excess of the water-loss. The roots are superficial in position, owing to the abundance of water at or on the surface of the soil. Root-surfaces are slightly developed and root-hairs often lacking, because the amount of water renders absorption easy. The surplus of water is a disadvantage, however, as it reduces the amount of air in the soil and hence cuts off the supply of oxygen necessary for the activity of the roots. This lack of aeration is compensated by the development of large air-passages leading down from the leaves through the stem and roots. Stems and leaves are almost invariably smooth and without any sort of protective covering. Breathing-pores are usually abundant and the necessity that the plant should lose a large amount of water has led to the development of water-pores and papillæ. This structure is typical of amphibious plants, that is, those that grow in the mud or in shallow water. Floating plants are usually much the same, with the exception that the breathing pores become useless and disappear on the under surface of the leaf, which is in contact with the water. Certain plants, such as the duckweed, have become greatly reduced in consequence of the floating habitat, and consist merely of a tiny, leaf-like disc, with a few rootlets. Submerged plants grow entirely beneath the water and are not subject to water-loss. As a result their leaves and stems are greatly reduced. The leaves are thin and divided into narrow segments; in structure they are almost uniform. The characteristic air-passages of the other water forms are lacking, as all the air must be dissolved in water.

Desert-plants are in most respects the exact opposites of water-plants. Not only is the water-supply scanty, but all the factors which increase water-loss are present in a large degree. Such plants must use all their power of adaptation to absorb and store all the water they can and to lose just as little by evaporation as possible. The roots of desert-plants are for the most part deep-seated and branch for the most part only in the deeper, moist soil. They are covered elsewhere with a corky layer to prevent the loss of water where the root passes through the dry upper layers. In the moist soil, root-hairs are produced in large numbers. In many cases the upper portion of the root consists of tissue especially adapted to the storage of water. The stems of xerophytes are short and stout. The leaves are thick and much reduced in size; and in extreme forms they are entirely lacking. Both leaves and stems are covered with a thick coating of hairs, or wax, or the epidermis is greatly thickened, all for the purpose of protection against water-loss. The breathing-pores are generally confined to the underside of the leaf and are often sunken far below the surface for still greater protection. In the cactus the leaves are reduced to mere scales and the stem often contracted into a cylinder or ball, thus decreasing the exposed surface to the minimum. Succulent plants, such as the live-for-ever and ice-plant have, on the other hand, been modified so that the leaves serve for the storage of water. Lichens and mosses which grow on rocks are capable of withstanding extreme dryness, a faculty seemingly inherent in their protoplasm, as they are without ordinary protective contrivances.

Moist-land plants, or mesophytes, stand as intermediate between the two preceding groups. The water-supply, though not excessive, is usually sufficient, and the humidity of the air is great enough to preclude the danger of excessive water-loss. In consequence, mesophytes have well-developed, more or less branched, root-systems, which are usually intermediate in position, but many of them are deep-seated. The development of surface is moderate, as well as that of the protective cork. Stems are for the most part tall and vigorous and much-branched. The leaves are large and mostly entire, or at least rarely finely dissected. Hairs are common, but seldom compacted into a dense covering. The epidermis is not greatly thickened and while the breathing-pores are often more abundant on the lower side, they are present in large numbers on both surfaces. The leaves of mesophytes are characterized regularly by compact rows of oblong cells placed at right angles to the surface, which are called palisade-tissue, and by loose irregular cells with large intercellular spaces, the sponge tissue. The former is usually in the upper, the latter in the lower half of the leaf. The palisade is differentiated in response to the action of strong light, while sponge-tissue results from the need of the rapid diffusion of the carbon dioxide and oxygen absorbed from the air.

Sun-plants and shade-plants are especially different in their leaves; this is to be expected, as the leaf is the organ most dependent upon light. The root-system will be more superficial in shade-plants, as the moisture is nearer the surface of the soil in shaded than in sunny places. The stem will be more slender, taller and often more branched, since it is necessary to place the leaves in the position to receive the most of the diffuse light. The leaves are broad, thin and entire, increasing the exposed surface, while in sun-plants they are thick and more or less divided. In typical shade-leaves, the palisade-tissue is reduced to a single row, or is altogether absent. The cells are not crowded closely and their longest axis often coincides with the epidermis of the leaf. Sun-leaves have one or more rows of typical palisade on the upper side and are frequently palisaded on the lower side also. The epidermis develops more wax and hairs in the sun; the breathing-pores are more numerous on the lower than upon the upper surface, while there is little difference in the shade.

Origin and Distinction of Forms.— Vegetation-forms doubtless originated in response to physical conditions, but this relation is hardly evident to-day. We can only see in trees, shrubs, herbs, etc., an expression of the success which different plants have obtained in the struggle for existence. It is also evident that the vegetation form of a plant has much to do with its persistence and hence with its importance in vegetation. The main groups of vegetation-forms are woody plants, herbs and thallus (flowerless) plants. The former are the largest, the most dominant, and the most persistent of all forms; the latter are tiny, subordinate and fleeting. The various woody forms are trees, shrubs, bushes and climbers; the first are the most important, the last the least so. Trees constitute the most permanent type of vegetation, the forest, to which shrubs, bushes and climbers also contribute. The relation between these forms is easily seen in the development of a forest, in which bushes precede and are followed by shrubs; these give way to the trees, the climbers coming in after the latter.

Herbs are specially distinguished from woody plants by their lack of woody stems and by the fact that their persistent parts are underground. They can never be very large, for their stems lack support, though they may persist for years. They are either perennial, blooming each year, or annual-biennial, blooming at the end of the first or second year, and then dying. Various forms of herbs are distinguished with reference to the position of the stem and leaves. In some, like the dandelion, the leaves are grouped in rosettes in response to light and heat. In others, such as the everlasting, the plants are set close together for somewhat similar reasons and perhaps for mutual protection also. Climbers, sweet peas, vetches, etc., develop partly for increased support, partly to secure more light. Grasses form sod because of their abundant rootstalks; it is this faculty which enables grasses to control the vegetation of meadows and prairies. Bunch-grasses are an exception, but they generally grow where the formation of a sod is impossible on account of unfavorable physical conditions. The position and abundance of herbs in a formation will depend also upon the character of the underground parts. Species with underground runners or rootstalks will be more abundant and more widely distributed than those with nearly stationary bulbs or tubers. The vegetation forms of thallus plants play a very subordinate rôle in vegetation. Mosses, liverworts and lichens are regularly present in tree and herb formations, but their small size and transient nature make them of little importance. They are significant of the early stages of vegetation on rocks, new soils, etc., but they soon disappear before the grasses and other herbs. Fungi are entirely dependent upon their host plant or stratum and are relatively insignificant, except where they are necessary to the nutrition of the host, as in the case of certain trees.

Plant Formations.— The vegetation of the earth's surface is not at all uniform, but consists of a large number of different areas, determined by climate and soil. The most extensive of these are known as formations, illustrated by the deciduous forest of the Mississippi Basin, the prairie-plains grassland, and the sage-brush desert of the Great Basin. Each formation is the product of a particular climate and hence represents the highest type of vegetation possible under it. For this reason, each formation is often called a climax or climax formation. The entire plant covering of the globe is made up of such climax formations. These are far from continuous or uniform, however, owing to the interruptions due to bodies of water, outcrops of rock, fire, cultivation and other disturbances. In such areas are to be found pioneer communities which develop through a series of stages until the final stage or climax for that particular climate is reached. Thus, each formation consists of two kinds of communities, developmental or successional ones which disappear in turn until the final stage is reached, and climax ones which persist for long periods and over vast areas as long as the climate remains essentially the same. The climax divisions of a formation are known as associations, consociations and societies, and are well illustrated by the grassland formation which covers the prairies and plains. The tall grasses of the prairie constitute one association made up of consociations of *Stipa, Agropyrum* and *Koeleria*, while the short grasses form a plains association consisting of the *Bouteloua* and *Bulbulis* consociations primarily. The societies are due to the presence of characteristic perennial herbs such as *Amorpha, Psoralea, Aster, Solidago,* etc., which dominate more or less distinct areas within the association.

Areas or Formations.— The vegetation of the earth's surface is not at all uniform, but consists of a multitude of different areas, each corresponding to a habitat. These areas are called formations and each is composed of an association or groups of plants determined by the physical factors of its habitat. A pond will be occupied by a community composed of water-plants; a forest formation will consist of mesophytes, and desert plant formations will be found in dry, sandy regions. Even within each formation it will be found that the plants are not uniformly distributed; some will occur in masses, while others are scattered singly, and one species will be met again and again, while another will be found but once. Furthermore, communities are not fixed groups of plants. One species will find that the conditions of life become more and more difficult; and will gradually disappear. Other species will prosper and increase rapidly in number, this very prosperity often producing the conditions unfavorable to another. The seeds of species from other places will be brought in by the wind, by birds or by animals, and will find a new home, or, after struggling for a while, the plants will disappear. Frequently, new plants come in to such a degree that they finally replace the original species entirely and the community is replaced by a new one.

The development of a formation may be readily followed where rocks are disintegrating, or where an original vegetation has been removed by fire. In the first case, the pioneer plants are small crust-like lichens, which decompose the surface of the rock, and by their decay prepare a thin soil for the larger leaf-like forms, which sooner or later appear. With these usually enter the rock mosses and the two by their activity and ultimate decay finally form a soil sufficient for some of the grasses and other herbs which are able to withstand extreme dryness. Meanwhile, the action of rain and frost has produced rifts in the rocks, which are first filled with mosses, and then by a soil deep enough to support larger plants. The ultimate result of the activity of these various factors is the breaking down of the rock into soil. In the case of the harder rocks, this will be a coarse sand or gravel; with the softer ones, it is a fine sand or marl. At this stage, leaf-like lichens and mosses play some part in binding the soil particles together, but they soon disappear before the grasses, which in their turn yield in a few years to other herbs. These are sooner or later displaced by bushes and shrubs and the latter make way for the trees which mark the close of the process. Such a primary succession takes place very slowly and may often extend over a century or more. When a forest is burned, the revegetation is much more rapid, as the soil is already prepared and the succession is termed secondary. Tiny mosses and fungi first appear and in a year or two at the most are replaced by low herbs. These disappear before the invasion of grasses and "fireweed," and these are replaced by fast-growing trees, such as the birch and the aspen. Such trees are usually shortlived and are displaced after a decade or so by pines, spruces or firs, which in many cases are at last conquered by the hardwoods. It is significant of the plants of each stage of such successions that they bring about conditions in their action upon the habitat which finally cause their own disappearance. Each stage represents a community, but the change from one stage to the next takes place so slowly that it is not at all uncommon to find associated with the plants typical of one stage some survivors of the preceding community, as well as a few pioneers of the next stage.

Migration of Plants.— The movement of plants in vegetation is known as migration. In the case of the simple water-plants, the algæ, the whole plant moves of its own accord, or is carried by some agent. The same holds for a few of the flowering plants of floating habit. All terrestrial plants are fixed, however, and migration must act regularly upon the spore or seed. In tumbleweeds, the whole plant is frequently carried away by the wind, but it is no longer in a living condition. Spores are readily scattered by the wind on account of their lightness, but seeds and fruits have been especially modified for migration on account of their greater weight. Plants growing in or near the water often have fruits with corky or inflated envelopes, which serve to keep them afloat. The great majority of the modifications for securing migration, however, are concerned with wind and animals. In the former, the contrivances are uniformly for the purpose of lightening the fruit or seed, so that it may readily be carried by the wind. Fruits that are to be distributed by animals are provided with spines, hooks or glands for attachment, or are made attractive by a bright or edible envelope. Wind-carried fruits are especially common; they are provided with wings, as in the maple; with hairs, as in the milkweed, and with parachute-like tufts, as in the dandelion. Man plays the most important part of all distributive agents, if voluntary as well as involuntary carriage be considered. He has carried cultivated plants and weeds all over the globe and to thousands of places where they could never have gone of themselves.

The movement of the seed or fruit of a species into a new formation or country is often

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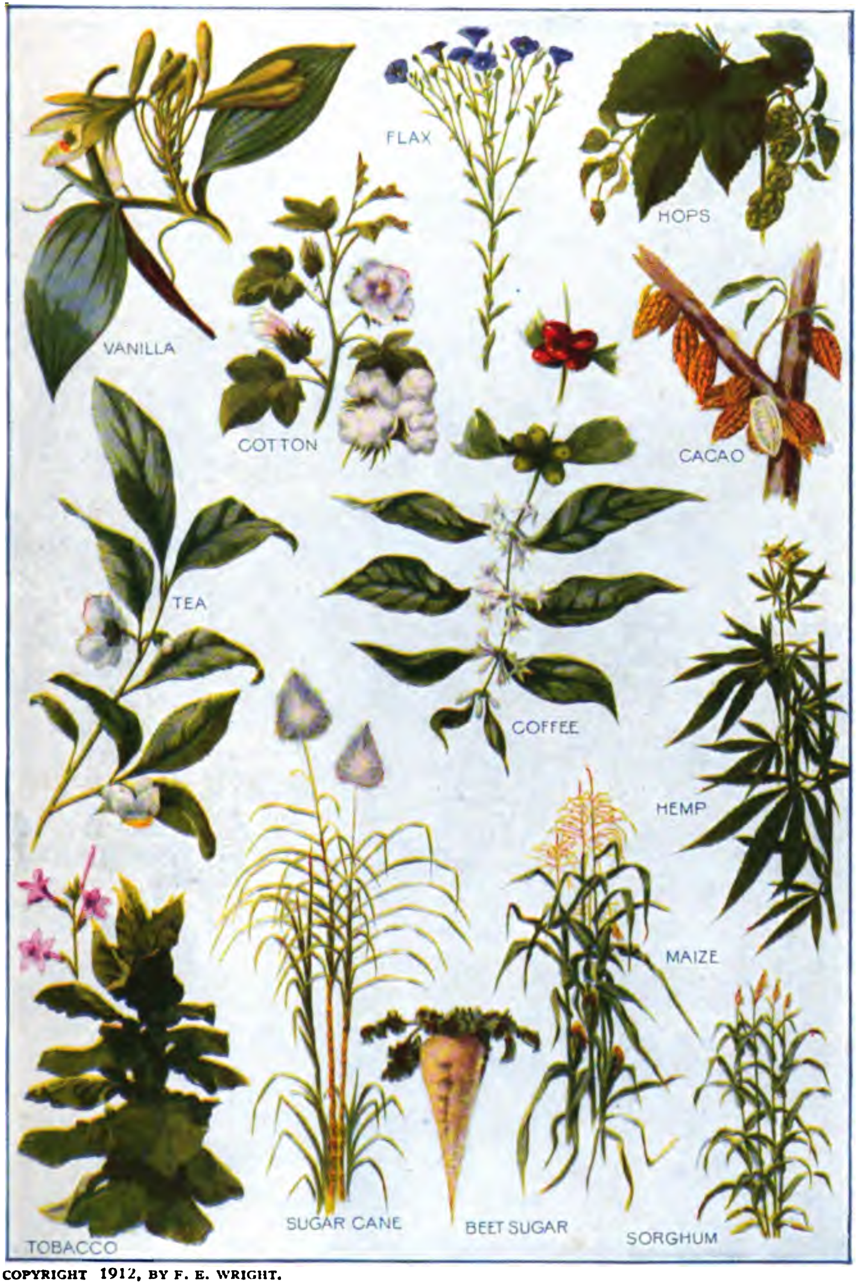

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PLANTS OF GREAT COMMERCIAL VALUE

determined by natural barriers. Winds bear seeds for long distances, but they are powerless to carry them across oceans, or over high mountain ridges. Similarly, a desert region is a barrier to seeds brought from a moist climate, and a cold climate prevents the naturalization of species coming from a warm country. The chance that seeds will germinate and grow is greatest when they are carried into a habitat similar to the original one and it is least when they are left in habitats very different from it. It is unquestionable that seeds have often been carried into many places where they were unable to secure a foothold. This fact explains why many species are found only in certain countries, or localities, and why it is that each formation retains a more or less distinctive impress.

North American Vegetation.— The vegetation of the North American continent owes its general features to the gradual decrease of heat to the northward, and the more or less constant decrease in the rainfall in passing from the coasts to the interior. The greatest development of forests is found in the warm coast-regions of the southeast, and of the Pacific. The poorest vegetation is found in the north, and on high mountains, where the temperatures are low, and in the interior where the rainfall is slight. The character and distribution of vegetation are chiefly determined by heat and water. As a result, the vegetative covering falls into zones corresponding in a general way to zones of temperature. If the distribution of moisture were uniform over the continent, the series of zones would be as follows: (1) the zone of evergreen tropical and subtropical trees; (2) the zone of deciduous trees; (3) the zone of cone-bearing trees; (4) the zone of grasses and other herbs; (5) the zone of mosses and lichens; (6) the zone of ice and snow. The rainfall decreases regularly from the coast inland, while a high mountain range makes an abrupt change in the amount. The Appalachian, Rocky Mountain and Sierra Nevada ranges act as barriers to the passage of moisture-laden winds, and turn into grass land or desert, regions that are sufficiently warm to be forested. The Appalachian barrier is too low to be very effective, and the forests yield to prairies only slowly and far inland. The Sierra Nevada and the Rocky Mountains are almost complete barriers, and they enclose a parched desert. The height of these ranges causes an abundant condensation on their slopes, and in consequence they are more or less heavily wooded. On account of the altitude, the temperature is low, and the forests are merely southerly extensions of the great boreal zone of pines and spruces. A general survey of the North American continent would show it to be wooded on the eastern, western, and southern coasts. In the north, there is a zone of grass and moss-covered barrens. In the interior there is a region of plain and prairie, stretching unbroken from Athabasca to Texas, and between the two great Cordilleran ranges from Washington to Central America lies a great desert region, broken repeatedly by intersecting lines of mountains. Running southward from the great northern forest mass of the continent are the three mountain systems. In the low Appalachian system, the arctic vegetation of the north is found on a few alpine peaks alone, but in the higher Rocky Mountains and the Sierra Nevada this long southward extension of dwarf herbaceous vegetation is almost continuous. All carry the northern pines and spruces far south, but in the lower range, these disappear in Virginia, while on the higher ranges they persist almost to the Mexican boundary. North America is thus seen to be covered with belts of vegetation running east and west, which are completely interrupted in the interior by high mountain ranges, which, together with the Appalachians, also serve to carry the northern forests southward in three long tongues.

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PLANT INDUSTRY. See Agriculture, Department of.

PLANT-LOUSE. See Aphid.

PLANT SOCIOLOGY. See Ecology; Plant Geography.

PLANTAGENET, plăn-tăj'ĕ-nĕt, a family whose various branches occupied the throne of England from the reign of Henry II (1154) until the accession (1485) of Henry VII, the representative in the female line of the Lancastrian branch of it, who, by his marriage (1486) with Elizabeth of York, daughter of Edward IV, representative of the York branch, united its various branches in the house of Tudor, of which he was the direct descendant. On the death of Henry I the Crown was claimed by his daughter, Maud or Matilda, first married to Henry V, emperor of Germany, and afterward to Geoffroi V, Count of Anjou, surnamed Plantagenet, on behalf of her son by the latter, Henry Plantagenet. Stephen obtained it during his lifetime and was succeeded on his death by Henry, who became the first of the Plantagenet kings. The name is said to have been derived from the circumstance of the Count of Anjou wearing a branch of broom (*plante de genêt*) in his cap. The direct line became extinct in Richard II (1399), before whose death the Crown was usurped by Henry IV, son of John of Gaunt, Duke of Lancaster, 4th son of Edward III, in prejudice of Edmund and Anne Mortimer, the descendants of Lionel, Duke of Clarence, 3d son of the same Edward. He was succeeded by his descendants, Henry V and Henry VI, and during the reign of the latter, Edmund Mortimer having died without heirs, Richard, Duke of York, son of Anne Mortimer, who had married the heir of Edmund, Duke of York, 5th son of Edward III, claimed the Crown. This occasioned the wars of the Roses, which terminated in the accession of Henry VII, as above mentioned. See England, *History;* and articles on individual monarchs.

PLANTAIN, several species of *Plantago,* a genus of the family *Plantaginaceæ.* Most of the 200 or more widely distributed species are weedy herbs or subshrubs. The best known species is the common plantain or ribgrass, an abundant weed throughout most of North America. It is a native of Europe, but was spread so rapidly by human agencies in America that the Indians sometimes called it "white man's foot." The leaves are sometimes used as pot herbs. Another well-known species is English plantain or ribwort (*Plantago lanceolata*), in America a pernicious lawn weed, but sometimes used in Europe upon sterile and dry soils as a fodder plant, the hot, dry summers favoring its growth in the United States and reducing the resistance of the grass. The only safeguards against it are thorough preparation and enrichment of the ground before planting to lawn, careful selection of pure lawn-grass seed and persistent care both in annual attention to the needs of the grass and the weeding. The seeds are used for bird-feeding. Numerous species are natives of North America.

PLANTAIN, Adam's Fig, or COOKING BANANA, a tropical herb of the family *Musaceæ*, considered as a distinct species (*Musa paradisiaca*) by some botanists and as a variety of the common banana by others. From India, where it is native, it has been taken by man to all tropical countries, and it forms a staple food both eaten raw and cooked in a variety of ways. It is, however, less palatable in the fresh state than the banana. The plants are propagated by suckers or cuttings of the rootstock. The former are cut from the parent plant with a spade and set where desired. The latter are transplanted from a propagating bed when they have one or two leaves. They succeed best in moist, rich soil. When about 18 months old they should bear a cluster of fruits, after which the stalk dies and new sprouts take its place and so continue for years.

PLANTAIN-EATERS, a family (*Musophagidæ*) of African picarian birds, classified near the parrots, with notched or saw-edged bills and usually of brilliant colors. The genus *Musophaga*, in which the base of the bill spreads over the forehead like a broad plate, includes the most typical West African forms. These birds feed chiefly upon the fruit of the banana and plantain. The members of the genus *Turacus* (or *Corythaix*), called «touracos,» possess a bill of ordinary size and conformation, and an erectile crest, borne on the head. The general color is green, the quills of the wings and tail being colored red by a peculiar pigment containing copper and named turacin. They feed on insects, in addition to fruits, and are said to be exceedingly familiar and tame in habits, even in a wild state. They attain a size averaging that of the common pigeon or crow. Consult Newton, 'Dictionary of Birds' (1893–96).

PLANTATION, a term anciently used to designate a colony. Plantations, according to Blackstone, are colonies where the lands are claimed by the right of occupancy only, by finding them desert and uncultivated, and peopling them from the mother country; or where, when already cultivated, they have been either gained by conquest or ceded by treaties. The term came into use in the United States in colonial times and is still preserved in the official title of the State of Rhode Island, namely, «Rhode Island and Providence Plantations.» The plantations of the southern United States were the chief centres of aristocracy before the emancipation of the negro slaves. Changing conditions are rapidly wiping out the old-time plantation, which is characteristic of agricultural countries, and disappears in the march of industry. The word plantation became popular in an extended and different meaning in the South, where it is still used to designate a large section of cultivated land; the estate of a large landed proprietor — equivalent to the «ranch» of the western United States or the hacienda of South America.

PLANTIGRADE ANIMALS, those which in stepping place the heel and whole sole of the foot upon the ground, for example, bears; as opposed to *digitigrade* animals, for example, cats, dogs, which step upon their toes. The term was applied by Cuvier to a section (*Plantigrada*) of the *Carnivora*, but has now no significance in classification.

PLANTIN, plăṅ-tăṅ, **Christophe**, French printer: b. Saint Avertin, France, 1514; d. Antwerp, 1 July 1589. He established at Antwerp in 1555 a printing press which became famous for the character of the work produced and later founded presses at Leyden and Paris. His most celebrated work is the 'Biblia Polyglotta' (8 vols., 1568–73). His office in Antwerp was purchased in 1877 by the city and now constitutes the Musé Plantin-Moretus. Consult 'Life' by Rooses (1892).

PLANTS, Alpine. See ALPINE PLANTS.

PLANTS, Beach. See BEACH PLANTS.

PLANTS, Breeding of. *Fundamental Principles.*— Only the most limited view of plant-breeding can be given in an ordinary thesis. It would be necessary to extend the subject through many volumes to give even a general view of what has already been demonstrated, and that which the clear light of science has yet to bring forth from the depths is too extensive even for the imagination to grasp, except through a full knowledge of what practical field-work has already accomplished.

The fundamental principles of plant-breeding are simple, and may be stated in few words; the practical application of these principles demands the highest and most refined efforts of which the mind of man is capable, and no line of mental effort promises more for the elevation, advancement, prosperity and happiness of the whole human race.

Every plant, animal and planet occupies its place in the order of Nature by the action of two forces — the inherent constitutional life-force with all its acquired habits, the sum of which is heredity; and the numerous complicated external forces or environment. To guide the interaction of these two forces, both of which are only different expressions of the one eternal force, is, and must be, the sole object of the breeder, whether of plants or animals.

When we look about us on the plants inhabiting the earth with ourselves, and watch any species day by day, we are unable to see any change in some of them. During a lifetime, and in some cases perhaps including the full breadth of human history, no remarkable change seems to have occurred. And yet there is not to-day one plant species which has not undergone great, and to a certain extent constant change.

The life-forces of the plant in endeavoring to harmonize and adapt the action of its acquired tendencies to its surroundings may, through many generations, slowly adapt itself to the necessities of existence, yet these same accrued forces may also produce sudden, and to one not acquainted with its past history most surprising and unaccountable, changes of character. The very existence of the higher orders of plants which now inhabit the earth has been secured to them only by their power of adaptation to crossings, for through the variations produced by the combination of numerous tendencies, individuals are produced which are better endowed to meet the prevailing conditions of life. Thus to Nature's persistence in crossing do we owe all that earth now produces in man, animals or plants; and this magnificently stupendous fact may also be safely carried into the domain of chemistry as well, for what is common air and water but Nature's earlier efforts in that line, and our nourishing foods but the result of myriad complex chemical affinities of later date?

Natural and artificial crossing and hybridization are among the principal remote causes of nearly all otherwise perplexing or unaccountable sports and strange modification, and also of many of the now well-established species. Variations, without immediate antecedent crossing occur always and everywhere from a combination of past crossings and environments, for potential adaptations often exist through generations without becoming actual, and when we fully grasp these facts there is nothing mysterious in the sudden appearance of sports; but still further intelligent crossings produce more immediate results and of great value, not to the plant in its struggle with natural forces, but to man, by conserving and guiding its life-forces to supply him with food, clothing and innumerable other luxuries and necessities. Plant-life is so common that one rarely stops to think how utterly dependent we are upon the quiet, but magnificently powerful work which they are constantly performing for us.

It was once thought that plants varied within the so-called species but very little, and that true species never varied. We have more lately discovered that no two plants are ever exactly alike, each one having its own individuality, and that new varieties having endowments of priceless value, and even distinct new species, can be produced by the plant-breeder with the same precision that machinery for locomotion and other useful purposes are produced by the mechanic.

The evolution and all the variations of plants are simply the means which they employ in adjusting themselves to external conditions. Each plant strives to adapt itself to environment with as little demand upon its forces as possible and still keep up in the race. The best-endowed species and individuals win the prize, and by variation as well as persistence. The constantly varying external forces to which all life is everywhere subjected demand that the inherent internal force shall always be ready to adapt itself or perish.

The combination and interaction of these innumerable forces embraced in heredity and environment have given us all our bewildering species and varieties, none of which ever did or ever will remain constant, for the inherent life-force must be pliable or outside forces will sooner or later extinguish it. Thus adaptability, as well as perseverance, is one of the prime virtues in plant as in human life.

Plant-breeding is the intelligent application of the forces of the human mind in guiding the inherent life-forces into useful directions by crossing to make perturbations or variations and new combinations of these forces, and by radically changing environments, both of which produce somewhat similar results, thus giving a broader field for selection, which again is simply the persistent application of mental force to guide and fix the perturbed life-forces in the desired channels.

Plant-breeding is in its earliest infancy. Its possibilities, and even its fundamental principles, are understood but by few; in the past it has been mostly dabbling with tremendous forces, which have been only partially appreciated, and it has yet to approach the precision which we expect in the handling of steam or electricity, and, notwithstanding the occasional sneers of the ignorant, these silent forces embodied in plant-life have yet a part to play in the regeneration of the race which by comparison will dwarf into insignificance the services which steam and electricity have so far given. Even unconscious or half-conscious plant-breeding has been one of the greatest forces in the elevation of the race. The chemist, the mechanic have, so to speak, domesticated some of the forces of Nature, but the plant-breeder is now learning to guide even the creative forces into new and useful channels. This knowledge is a most priceless legacy, making clear the way for some of the greatest benefits which man has ever received from any source by the study of Nature.

A general knowledge of the relations and affinities of plants will not be a sufficient equipment for the successful plant-breeder. He must be a skilful botanist and biologist, and having a definite plan, must be able to correctly estimate the action of the two fundamental forces, inherent and external, which he would guide.

The main object of crossing genera, species, or varieties is to combine various individual tendencies, thus producing a state of perturbation or partial antagonism by which these tendencies are, in later generations, dissociated and recombined in new proportions, which gives the breeder a wider field for selection; but this opens a much more difficult one — the selection and fixing of the desired new types from the mass of heterogeneous tendencies produced, for by crossing bad traits as well as good are always brought forth. The results now secured by the breeder will be in proportion to the accuracy and intensity of selection, and the length of time they are applied. By these means the best of fruits, grains, nuts and flowers are capable of still further improvements in ways which to the thoughtless often seem unnecessary, irrelevant or impossible.

When we capture and domesticate the various plants, the life-forces are relieved from many of the hardships of an unprotected wild condition, and have more leisure, so to speak, or, in other words, more surplus force, to be guided by the hand of man under the new environments into all the useful and beautiful new forms which are constantly appearing under cultivation, crossing and selection. Some plants are very much more pliable than others, as the breeder soon learns. Plants having numerous representatives in various parts of the earth generally possess this adaptability in a much higher degree than the monotypic species, for having been subjected to great variations of soil, climate and other influences, their continued existence has been secured only by the inherent habits which adaptation demanded, while the monotypic species not being able to fit themselves for their surroundings without a too radically expensive change, have continued to exist only under certain special conditions. Thus two important advantages are secured to the breeder who selects from the genera having numerous species — the advantage of natural pliability, and in the numerous species to work upon by combination for still further variations.

The plant-breeder before making combinations should with great care select the individual plants which seem best adapted to his purpose, as by this course many years of experiment and much needless expense will be avoided. The differences in the individuals which the plant-breeder has to work upon are sometimes extremely slight. The ordinary unpractised person cannot by any possibility discover the exceedingly minute variations in form, size, color, fragrance, precocity and a thousand other characters which the practised breeder perceives by a lightning-like glance. The work is not easy requiring an exceedingly keen perception of minute differences, great practice, and extreme care in treating the organisms operated upon, and even with all the naturally acquired variations added to those secured by scientific crossing and numerous other means the careful accumulation of slight individual differences through many generations is imperative, after which several generations are often, but not always, necessary to thoroughly «fix» the desired type for all practical purposes.

The above applies to annuals or those plants generally reproduced by seed. The breeder of plants which can be reproduced by division has great advantage, for any valuable individual variation can be multiplied to any extent desired without the extreme care necessary in fixing by linear breeding the one which must be reproduced by seed. But even in breeding perennials the first deviations from the original form are often almost unappreciable to the perception, but by accumulating the most minute differences through many generations the deviation from the original form is often astounding. Thus by careful and intelligent breeding any peculiarity may be made permanent and valid new species are at times produced by the art of the breeder and there is no known limit to the improvement of plants by education, breeding and selection.

The plant-breeder is an explorer into the infinite. He will have «No time to make money,» and his castle, the brain, must be clear and alert in throwing aside fossil ideas and rapidly replacing them with living, throbbing thought followed by action. Then, and not till then, shall he create marvels of beauty and value in new expressions of materialized force, for everything of value must be produced by the intelligent application of the forces of nature which are always awaiting our commands.

The vast possibilities of plant-breeding can hardly be estimated. It would not be difficult for one man to breed a new rye, wheat, barley, oats or rice which would produce one grain more to each head or a corn which would produce an extra kernel to each ear, another potato to each plant or an apple, plum, orange or nut to each tree.

What would be the result? In five staples only in the United States alone the inexhaustible forces of Nature would produce annually, without effort and without cost. 5,200,000 extra bushels of corn, 15,000,000 extra bushels of wheat, 20,000,000 extra bushels of oats, 1,500,000 extra bushels of barley, 21,000,000 extra bushels of potatoes.

But these vast possibilities are not alone for one year or for our own time or race, but are beneficent legacies for every man, woman and child who shall ever inhabit the earth. And who can estimate the elevating and refining influence and moral value of flowers with all their graceful forms and bewitching shades and combinations of colors and exquisitely varied perfumes? These silent influences are unconsciously felt even by those who do not appreciate them consciously, and thus with better and still better fruits, nuts, grains and flowers will the earth be transformed, man's thoughts turned from the base, destructive forces into the nobler productive ones which will lift him to higher planes of action toward that happy day when man shall offer his brother man, not bullets and bayonets, but richer grains, better fruits and fairer flowers.

Cultivation and care may help plants to do better work temporarily, but by breeding, plants may be brought into existence which will do better work always in all places and for all time. Plants are to be produced which will perform their appointed work better, quicker and with the utmost precision.

Science sees better grains, nuts, fruits and vegetables, all in new forms, sizes, colors and flavors, with more nutrients and less waste and with every injurious and poisonous quality eliminated and with power to resist sun, wind, rain, frost and destructive fungus and insect pests; fruits without stones, seeds or spines; better fibre, coffee, tea, spice, rubber, oil, paper and timber trees, and sugar, starch, color and perfume plants. Every one of these and 10,000 more, are within the reach of the most ordinary skill in plant-breeding. On the plant-breeder now rests one of the next great world movements, the guidance of the creative forces are in our hands.

Man is slowly learning that he too may guide the same forces which have been through all the ages performing this beneficent work which he sees everywhere above, beneath and around him in the vast teeming animal and plant life of the world.

These lines were penned among the heights of the Sierras, while resting on the original material from which this planet was made. Thousands of ages have passed and it still remains unchanged. In it no fossils or any trace of past organic life are ever found, nor could any exist, for the world creative heat was too intense. Among these dizzy heights of rock, ice-cleft, glacier-plowed and water-worn, we stand face to face with the first and latest pages of world creation, for now we see also tender and beautiful flowers adding grace of form and color to the grizly walls and far away down the slopes stand the giant trees, oldest of all living things, embracing all of human history; but even their lives are but as a watch-tick since the stars first shone on these barren rocks, before the evolutive forces had so gloriously transfigured the face of our planet home.

LUTHER BURBANK.

PLANTS, Classification of. *Vegetable kingdom.* All the plants in the world are most easily considered in systematic order, especially with reference to their arrangement in branches, classes, orders, etc. On account of the vast numbers of known species of plants (nearly 250,000) it is necessary that they should be arranged in an orderly system, for in this way only can we readily refer to or remember them. Of course, there may be many useful systems of plants, that is, systematic arrangements of the thousands of species, and in fact many systems have been proposed from time to time by different botanists. More than 300 years ago, Cesalpino, in Italy, proposed a system in which the 15 classes which he recognized were separated primarily into «trees» and «herbs,» and these were again distinguished by their fruits and seeds. A half century later Morison, in England, devised a system of 18 classes based upon characters of the plant as a whole (trees, shrubs, herbs, etc.), the inflorescence and the fruit. About 200 years ago Ray, in England, published his system of 23 classes, in which he still adhered to the time-honored primary division into «herbs» and «trees,» the former of which he divided into the «imperfect» (seaweeds, fungi, mosses, ferns, etc.), and the «perfect» herbs. His «perfect» plants were divided into «dicotyledons» and «monocotyledons,» as they are to this day, and several of his classes were practically identical with some of the families of the present time, as Umbelliferae, Leguminosae, grasses, etc. About the same time Bachmann, in Germany, proposed a system in which he rejected the common division into trees, shrubs and herbs, and based his 18 classes upon the form of the flower; first, whether regular, irregular or incomplete, and then, whether monopetalous, dipetalous, tripetalous, etc. At the same time Tournefort, in France, proposed still another system and based his 22 classes on characters derived from the corolla. However, he still adhered to the division into herbs and trees. Linné, in Sweden, a little more than 160 years ago gave the world his so-called sexual system, in which the number and relation of the stamens characterized the 24 classes, which were again divided into orders, mainly upon characters derived from the pistils. This system, while quite artificial, was very useful in enabling botanists to arrange their rapidly increasing knowledge of plants, and it was very generally used for a century.

We owe to Linné also the suggestion of a more natural system, which he published in fragmentary form contemporaneously with his sexual system. He recognized the greater groups Acotyledons, Monocotyledons, Dicotyledons and Polycotyledons, and such smaller ones as the Orchideæ Liliaceæ, Gramina, Coniferæ, Amentaceæ, Compositi, Umbellatæ, Bicornes, Pomaceæ, Drupaceæ, Caryophyllei, Asperifoliæ, Stellatæ, Papilionaceæ, Siliquosæ, Personatæ, Filices, Musci, Algæ, Fungi, etc., which have since been incorporated into most natural systems under these or slightly different names. Half a century later this bore fruit in the system of Jussieu (in France) which divided the vegetable kingdom into Acotyledons, Monocotyledons, and Dicotyledons, and recognized 15 classes and 100 families. The dicotyledons were divided into Apetalæ, Monopetalæ and Polypetalæ, and the higher families were essentially identical with many of those now generally recognized. Thirty years later (1819) DeCandolle modified Jussieu's system, reversing the sequence so as to proceed from the higher to the lower, and dividing the petaliferous dicotyledons into the Thalamiflorals, Calyciflorals and Corolliflorals. He recognized 161 families of plants of all kinds. Over 50 years ago the Candollean system was further modified by Bentham and Hooker, and until recently this has been the commonly accepted system in English and American botanical textbooks.

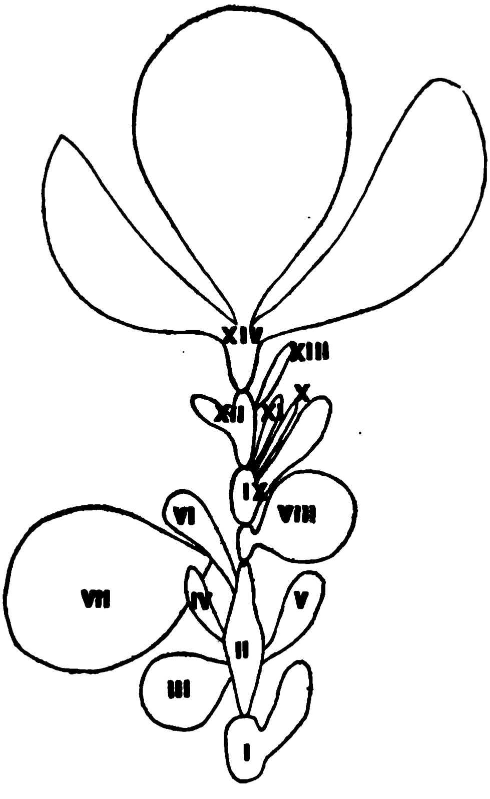

Chart showing the relationship of the phyla of the Vegetable Kingdom, the respective areas being proportional to the present number of species in each phylum.

About 35 years ago Eichler (in Germany) published his system, in which the vegetable kingdom was separated into five «divisions,»—Thallophyta, Bryophyta, Pteridophyta, Gymnospermæ, and Angiospermæ, and under these were about eight classes and nearly 40 orders. This by modification has given rise to the system of Engler (in Germany) now in common use in the United States, which in its latest form recognizes 13 primary «divisions» of the vegetable kingdom, 38 classes, about 100 orders and nearly 600 families.

The system outlined below, while conforming in numerous points with that of Engler, differs from it in many fundamental as well as minor points. It is an attempt to make the system conform to the author's conception of the course of evolution in the vegetable kingdom. The general relations of the classes to one another may be indicated by the chart on the preceding page.

Phylum I. Myxophyceæ.— The Slime Algæ — Single cells or groups or threads ot cells; blue-green to brown-green or in some cases colorless; reproduction typically by fission, rarely by internal cell formation; sexual reproduction lacking; cell walls usually soft; often secreting a gelatinous substance within which the plants remain imbedded. Fresh water and marine, one order hysterophytic and omnipresent. Two classes are recognized.

Class 1. *Archiplastideæ.* Nucleus illy defined; chloroplasts not differentiated; cell walls containing chitin. About 2,000 species.

Order 1. *Chroococcales.* The plants of this order are strictly unicellular or grouped into irregular or regular colonies, but not filamentous; coloring matter present. (Fig. 1). Two families, mostly of fresh water.

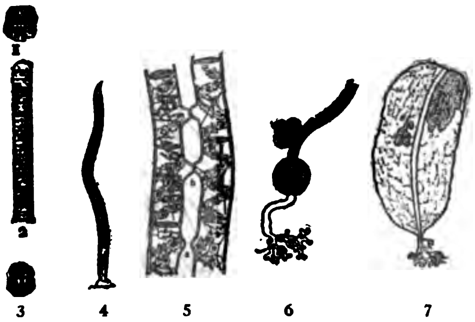

Fig. 1.— A cell of Chroococcus in process of fission; much magnified.
Fig. 2.— Part of a filament of Oscillatoria; much magnified.
Fig. 3.— A cell of Protococcus which has divided into three cells, which have not yet separated; much magnified.
Fig. 4.— A young filament of Uronema; much magnified.
Fig. 5.— Parts of two filaments of Spirogyra just before the fusion of the protoplasm of contiguous cells; much magnified.
Fig. 6.— Part of plant of Vaucheria, showing root below and green filament above, with antherid and two oogones; much magnified.
Fig. 7.— A whole plant of Dictyoneuron; much reduced.

Order 2. *Oscillatoriales.* In this order the cells are in threads which mostly do not branch; colored blue-green to brown-green; some species inhabit hot springs. Six families, including such genera as Oscillatoria (Fig. 2), Nostoc, Rivularia, etc.

Order 3. *Bacteriales.* The Bacteria. Usually minute, filamentous, or by the early solution of the filament few or one celled; lacking chlorophyll, hence saprophytic or parasitic on plants or animals, frequently causing diseases; some genera motile by flagella. A large and important group of omnipresent forms of the utmost importance. The larger filamentous forms are certainly closely related to the foregoing order, but there is considerable uncertainty as to the relationship of the more minute, one-celled genera. Seven or more families.

Class 2. *Holoplastideæ.* Nucleus with definite membrane; typical chloroplasts present. Only one order of about 20 species.

Order 4. *Glaucocystales.* **Minute, one-celled,** fresh water algæ.

Phylum II. Chlorophyceæ.— The Simple Algæ. Single cells, irregular or regular colonies, plates or most often filaments of cells; bright green, or rarely colorless; nucleus with membrane; chloroplasts well developed; cell walls of cellulose or related substance; reproduction by fission or internal development of zoospores or both, and usually also by the union of equal motile gametes or small motile sperm and feebly motile or non-motile egg to form a thick-walled zygote. Chiefly fresh water plants, a few genera, however, almost exclusively marine. Two classes are here recognized.

Class 3. *Protococcoideæ.* The Green Slimes. The plants of this class are strictly unicellular or united into irregular or regular colonies; mainly found in fresh water or moist places. Over 400 species, many world-wide in their distribution. One of the latter, Protococcus (Fig. 3), forms a green, paint-like coating on damp walls, tree trunks, etc. Two orders are recognized.

Order 5. *Tetrasporales.* The plants of this small order are embedded in gelatinous colonies, or provided with gelatinous stalks in some of the genera that do not form colonies. Reproduction is both by division of the cells and by zoospore formation, frequently besides by the union of equal motile gametes. Perhaps four families should be distinguished.

The order *Volvocales* is clearly closely related to the foregoing order, but is distinguished by the fact that the cells retain their flagella and remain motile, even in their vegetative state. On the other hand they present no sharp line of demarcation from the Flagellates among the animals, so that it seems best to exclude this order from the vegetable kingdom, looking upon it as perhaps the bridge between the two kingdoms.

Order 6. *Protococcales.* In this order the plants lack the gelatinous stalks or matrix. Furthermore, with a very few exceptions of rather uncertain relationship, the asexual reproduction takes place only by the internal division of the vegetative cells into motile zoospores or non-motile autospores, the ordinary type of fission of the cells being absent. Those forms with zoospores frequently also possess sexual reproduction by the union of equal or unequal motile gametes. All of the 10 or more families are green except the Synchytriaceæ, which consist of minute parasites in the cells of higher plants.

Class 4. *Confervoideæ.* The Confervas are filamentous (rarely stratose) plants which may be branched or less often simple. The color is usually bright green. Asexual reproduction is mostly by the setting free of motile zoospores, although in some genera these are replaced by autosphores. Sexual reproduction shows all gradations from the union of gametes which are equal and motile to those in which both gametes are motile but unequal and finally to forms where only the small sperm cells are motile while the eggs are large and non-motile within the mother cell (oogone). While a few forms are marine the great majority occur in fresh water. In moist climates many species are terrestrial and some are found on the leaves of tropical evergreen trees. A few species enter such leaves and pass a partially parasitic existence. Over 600 species distributed unequally among five orders, of which the following are the most important:

Order 7. *Chætophorales.* Unbranched or mostly branched filaments, usually attached; in one family, sheets or tubes of cells; sometimes flat discs; cells normally with one chloroplast with but a single pyrenoid, and with a single nucleus; cell wall usually in one piece; asexual reproduction by various types of zoospores; sexual reproduction by the union of equal or unequal motile gametes. The plants of this order vary considerably in size. The delicate unbranched thread-like Uronema (Fig. 4) is barely one of two millimeters long, while some of the beautiful, much branched species of Draparnaldia exceed 10 centimeters in length. The delicate marine plants known as Sea Lettuce from their resemblance to a leaf of lettuce, are sometimes over a metre long.

Order 8, *Microsporales* and order 9, *Prasialales,* each with but a single family and but few species, are filamentous algæ undoubtedly related to the foregoing order and by some authors included in it.

Order 10, *Oedogoniales* consist entirely of fresh-water filamentous forms, either unbranched or branched. The asexual reproduction is by means of large zoospores produced singly in the vegetative cells of the filament. In their sexual reproduction a higher stage is attained than in any of the groups yet mentioned. In certain specially modified cells are produced one or two small, motile sperms which swim to the large non-motile eggs which are produced singly in special, swollen cells which are provided with an opening to permit the entrance of the sperm. There are approximately 250 species known from all parts of the world, divided into three genera, forming one family.

Order 11. *Coleochætales.* The few species of the single genus of this order are exclusively fresh-water forms and small. They live attached to objects in the water, such as stems of plants, sticks, etc., and form more or less circular discs (Fig. 10) or more rarely low cushions, in which the branched filaments are radially arranged. Many of the cells bear long, bristle-like extensions. Asexual reproduction consists of the formation of motile zoospores, singly in the vegetative cells; sexual reproduction occurs by the union within the usually long-necked oogone of the single large, non-motile egg and a small motile sperm which has been produced singly in a small terminal antherid. The great advance in this order is that after fertilization of the egg the surrounding vegetative cells send out branches that tightly invest the oogone in a protective coat. After a period of rest the fertilized egg divides into eight to 16 cells, each of which develops a single zoospore which produces a new plant.

Phylum III. Zygophyceæ.— The Conjugate Algæ — Aquatic chlorophyll-containing plants forming delicate, unbranched filaments which may be many centimeters long or reduced to but few cells. In many cases they consist of single cells which separate as soon as they divide. A comparative study of the various forms of this variable group makes it seem probable that these latter are to be considered as descended from long filamentous forms which have broken up early so as to be few or one-celled. Asexual reproduction is by fission only, with the doubtful exception of some little known forms. Sexual reproduction is by the fusion of the protoplasmic contents of two contiguous cells, either by means of a tube formed as a result of the contact of the cells, or by the breaking apart of the cell walls so that the two masses of protoplasm lie in contact in the space between the cells. The result of the union is the formation of a thick-walled resting spore (zygospore). Throughout the phylum the cells possess but a single nucleus and one to several, definite chloroplasts, colored either green or brown. The filamentous forms of the two classes form the connecting link as the one-celled species are extreme modifications of the group in different directions.

Class 5. *Conjugatæ.* These are plants with bright green chloroplasts and with cellulose walls. They are confined to fresh water and usually have a slimy coating which makes them slippery to the touch. They may be long filaments or in one order more often reduced to short filaments or separate cells.

Order 12. *Zygnematales.* Pond Scums. These plants are long filaments usually floating in the water, rarely attached, with chloroplasts star, band or disc shaped. The well-known Spirogyra (Fig. 5) with its spirally wound chloroplasts is a favorite subject of microscopic study. About 150 species.

Order 13. *Desmidiales.* Desmids. The beautiful plants belonging to this order are almost all visible only under the microscope. The more primitive forms possess filaments but most of the 2,100 species are one-celled. The cell wall is frequently constricted at the middle and mostly roughened with spines or tubercles. The cell wall typically is in two pieces which meet at the middle of the cell. A few species are motile, being able to glide along, but they lack flagella. Two or three families are recognized.

Class 6. *Bacillarioideæ.* Diatoms. The plants of this class are also microscopic. Their mode of reproduction is much like that of the foregoing class. Like the Desmids their walls are in two distinct halves which either meet at their edges or overlap a little like the cover and base of a pill-box. The walls are heavily impregnated with silica and are in consequence almost indestructible, so that they persist for hundreds of thousands of years as fossils, the well-known and valuable "diatomaceous earth." The chlorophlasts are disc shaped or elongated, and brown in color. These plants are found in fresh and salt water from the Arctic and Antarctic zones to the Equator. The more than 5,000 species are distributed in two orders of six to eight families each.

Order 14. *Eupodiscales.* Round Diatoms. Mostly marine, cells round or polygonal in end view of the filament.

Order 15. *Naviculales.* Flat Diatoms. Fresh water and marine; filament flattened so that in end view it is elliptical or boat-shaped.

Phylum IV. Siphonophyceæ.— The Tube Algæ. In all of the plants mentioned hitherto the cells, with rare exceptions, were provided with but a single nucleus. In this phylum, however, we find the type of cell structure known as a coenocyte, a sort of compound cell that has many nuclei embedded in the cytoplasm instead of the one. Furthermore, the growth of the plants of this group, which are almost all filamentous, or modifications of filaments, is mostly terminal, instead of occurring at all points in the filament as was the case in the preceding phyla. Aside from these points of difference the phylum shows many points of similarity to the Chlorophyceæ from which it doubtless arose. The plants are rather coarse, more or less branched filaments, bright green in color (rarely red in a few forms) or colorless in the species that lack chlorophyll. The colored forms are aquatic and for the most part marine; the colorless forms are fresh-water or terrestrial. Asexual reproduction is by means of motile zoospores or in some of the colorless species by the formation of wind-borne cells that are not motile. Sexual reproduction is by the union of equal or unequal motile gametes, or of motile sperms and nonmotile eggs, or by the direct union of protoplasm of sperm and egg through a connecting tube, the result in any case being a more or less thick-walled resting spore. About 1,200 species, probably best disposed in three classes. It is possible that some of the plants included in this phylum are descended from some of the class Protococcoideæ and others from the class confervoideæ, but that is a disputed point.

Class 7. *Siphonocladeæ*. Plants consisting of microscopic or moderate sized bladders from which may sprout smaller bladders or short filaments, or, of coarse filaments constricted or segmented at intervals to form numerous coenocytes. The filamentous forms are mostly branched, either irregularly or in definite patterns, often with the branches whorled; chloroplasts small disks or more often large and net-like; about 425 species, marine in most cases; a few families also contain fresh-water species. Reproduction asexually usually by zoospores, sexually (where known) by the union of equal, motile gametes, or of non-motile egg with motile sperm, to form a zygote which may germinate immediately or function as a resting spore.

Order 16. *Siphonocladales* is the only order in this class. In fresh water may be frequently found the filamentous Water Flannels (Cladophora); on damp, clayey soil often appear the minute bladder-like, green plants of Botrydium. In the ocean, particularly in the warmer waters, are found large numbers of plants of this order, among them the Mermaid's Wineglasses (Acetabulum) with calcified slender stem bearing at its apex a whorl of united, spore-bearing segments, forming a structure resembling some of the more delicate mushrooms. Four or five families are recognized.

Order 17. *Charales*. Stoneworts. (Fig. 24). The relationship of this group is obscure. It seems likely that it should be placed in the vicinity of those members of Class Siphonocladales which possess whorled branches. The plants of this group are inhabitants of fresh water, chiefly shallow lakes and ponds, and are frequently incrusted with lime. They consist of long septate tubes with whorls of branches at the joints, these in turn often with similar whorls of branches; the ultimate branches are the so-called leaves, which are cylindrical, pointed coenocytes. Asexual reproduction does not occur except by the formation of buds or of bulb-like structures. Sexual reproduction by the union of a minute motile sperm with the single large, non-motile egg contained within the oogone which is surrounded by a tight protective layer of spirally wound threads. Over 200 species, divided into six genera, in two families. Chara and Nitella are the genera most frequently found.

Class 8. *Siphoneæ*. Tube Algæ. These plants consist of elongated tubes, branched irregularly or so as to produce definite structures; these tubes are coarse and not septate, except for the production of the zoospores by which asexual reproduction mostly takes place, or of the gametes, which are (where known) always unequal, both sexes being motile in some cases or the female gamete (egg) non-motile and retained within the oogone. The plants are typically green, with numerous disc-shaped chloroplasts. In a few marine forms a violet color conceals the green to some extent. Probably two orders should be recognized.

Order 18. *Bryopsidales*. Marine forms of moderate size or sometimes large; irregularly branching coarse, non-septate, coenocytic threads or tangled masses of such threads forming definite structures, in one family the large coenocyte differentiated into parts functioning as roots, stems and leaves; asexual reproduction where known by formation of zoospores in lateral zoosporangia or by the breaking up of the plant; sexual reproduction where known by the union of unequal motile gametes; confined mostly to warmer waters. The genus Codium contains representatives forming rope-like masses sometimes several feet long; Caulerpa forms a creeping, branched stem, rooted at intervals and sometimes several feet long with upright, sometimes leaf-like branches several centimeters high. Its only mode of reproduction, so far as known, is the death of the older connecting stems so that the plant becomes separated into independent individuals. About four families, exclusively marine.

Order 19. *Vaucheriales*. Green Felts. The plants of this order are coarse, branching, green tubes, mostly forming dense tangled felts. They are confined to fresh water or to wet earth, except the few species of one family which, although green, are parasitic. Asexual reproduction by large zoospores formed in segments at the ends of the filaments, rarely by non-motile spores (aplanospores) formed within the filament. Sexual reproduction (wanting in the parasitic forms) by the union of motile sperm and nonmotile egg within the oogone. Two families. Here we find the common Green Felt (Vaucheria — Fig. 6, common in springs, damp ground, slow-moving streams, etc., as well as the peculiar leaf parasite of Aroids (Phyllosiphon).

Class 9. *Phycomyceteæ*. Tube Fungi or Lower Fungi. These plants are undoubtedly derived from the order Vaucheriales, but differ in several particulars. They lack chlorophyll and hence are either parasitic in their mode of life or feed on dead organic substances. They consist of long, usually irregularly branched, nonseptate tubes (sometimes septate in old age) which may be all alike or which may show distinction of vegetative portion contained within the substratum upon which the plant is feeding and a usually coarser external reproductive part. Asexual reproduction varies from the formation of zoospores in terminal zoosporangia, which remain attached, to the production, on the one hand, of separable zoosporangia (conidia) which produce zoospores only when they fall into water and in some genera fail to produce zoospores at all, and on the other hand, of aerial sporangia within which are produced nonmotile, walled spores which are set free by the rupture of the sporangium. Sexual reproduction in the more primitive forms is close to that in Vaucheria, consisting of the union of motile sperm with non-motile egg within the oogone; a more advanced step is the use of a conjugation tube to transfer the sperm nucleus to the oogone; the most advanced case being the reduction of the differences between the male and female reproductive organs until they are almost equal and similar (as in some sorts of Mucor). The plants of this class are aquatic, or parasitic within land plants, or saprophytic and terrestrial. They are mostly easily visible to the naked eye. About 400 species, distributed in four orders.

Order 20. *Saprolegniales.* Water Molds. These are aquatic fungi with zoospores produced in permanently attached zoosporangia. Some of them are troublesome parasites on young fish in fish hatcheries, especially species of Saprolegnia and Achlya, others are serious pests of seed beds (Pythium). About six families.

Order 21. *Peronosporales.* Downy Mildews. These are parasites of higher plants within which they live, sending out their reproductive branches to produce their conidia which in most cases produce zoospores when they fall into water. The fungi causing respectively Late Blight of potato (Phytophthora), Downy Mildew of grape (Rhysotheca), White Rust of cabbage and radish (Albugo), are among the most common. Two families are recognized.

Order 22. *Mucorales.* Terrestrial; spores usually produced in aerial sporangia; but little difference between male and female structures in sexual reproduction. Saprophytic; sometimes parasitic on other fungi. Four families of interesting fungi including the ubiquitous Black Mold of bread (Mucor).

Order 23. *Entomophthorales.* Insect Fungi. These are minute fungi mostly parasitic within the bodies of insects which they kill. The asexual spores are produced singly on short branches which emerge from the body of the insect. The male and female reproductive organs are scarcely distinguishable. Here belongs the Fly Fungus which kills flies in large numbers in the early autumn (Entomophthora).

Phylum V. PHÆOPHYCEÆ.— Brown Algæ. This group is composed of filamentous or, more commonly, massive plants, the latter of considerable dimensions and often differentiated into roots, stems and leaves. They are of a brownish-green color, due to the presence of a brown pigment which hides the bright green of the chlorophyll. The cells are uninucleate and the chloroplasts are small and disc-like or larger and net-formed. With a very few exceptions the members of this phylum are exclusively marine. The thousand or so species are divided into three classes.

Class 10. *Phæosporeæ.* The Kelps. These range from small filamentous branching plants to enormous plants hundreds of feet in length with stems, roots and leaves. Asexual reproduction occurs throughout the class by the formation of zoospores which are biflagellate and pear or kidney shaped. The organs in which they are produced, the zoosporangia, are often collected in patches on the surface of the plant (Fig. 7). Sexual reproduction is known in many of the forms and consists of the union of equal or unequal motile gametes which are very similar to and sometimes indistinguishable from the zoospores. In a few forms the eggs appear to lack power of motion. The approximately 500 species of this class are largely found in the cooler parts of the ocean. They may be divided into three orders as follows:

Order 24. *Ectocarpales.* Gametes all motile and equal or nearly so, or the egg non-motile; from filamentous to massive forms. Perhaps 16 families should be recognized. Among the common plants of this order are the Devil's Aprons (Laminaria) which consist of a stout stem with roots below and terminating above in a broad, often longitudinally split, leathery leaf, the whole sometimes attaining a length of one to several yards and a width of a foot. The Giant Kelp (Macrocystis) of the Pacific Ocean is no doubt the longest plant in the world, sometimes reaching the enormous length of 700 feet. It consists of a long, tough, round stalk, an inch or more in diameter and many feet in length with large branching roots below and bearing many narrow leaves, two to four feet long, each having a large air vessel (an inch in diameter and four or five inches long) in its petiole. By means of these air vessels the leafy portion of the plant floats out at the surface of the water. Nor are the Sea Trees (Lessonia) also of the Pacific Ocean, any less interesting. They consist of erect stems, rooted below and branched above, the latter bearing many pendent narrow leaves. Some of these veritable trees are several yards in height. The pretty Mermaid's Strings (Chorda) are flexible, string-like stems, a yard or so in length, rooted below and smooth and delicately fringed above. They occur in the Atlantic and Pacific oceans. Dictyoneuron (Fig. 7) of the Pacific Coast of North America is a foot or so long.

Order 25. *Cutleriales.* The plants of this order are small to several inches tall, disc-shaped or erect and more or less flattened and sometimes much divided, frequently in a dichotomous manner. Asexual reproduction is by means of zoospores which are produced in different plants from those producing the gametes. The gametes are motile, but differ exceedingly in size for the two sexes. Usually the fertilized egg produces a zoospore-bearing plant and vice versa, but this is not always the case.

Order 26. *Tilopteridales.* Filamentous plants with typical zoospores and with small, motile sperms and large, non-motile eggs which are produced singly in the oogones and set free before fertilization. Only a few species of little importance and infrequent in occurrence.

Class 11. *Dictyotineæ.* The few species (about 130) included in this class in its single order.

Order 27. *Dictyotales,* are wholly marine, mainly in those portions of the sea where the water is fairly warm. They are of moderate size, growing fast to rocks or other objects, as in the preceding class. They are differentiated into basal holdfast or root and vegetative shoot which is usually more or less flattened. It consists of several layers of cells, but there is little tissue differentiation. Sexual reproduction is by means of non-motile eggs, set free singly from superficial, crowded oogones and fertilized by minute, motile sperms produced in large numbers in similarly clustered, superficial antherids. These fertilized eggs give rise to similar plants, which, however, do not bear sexual organs, but reproduce by the production, in fours, of naked "tetraspores" which in their turn produce the sexual plants. Dictyota (Fig. 8) is the principal genus.

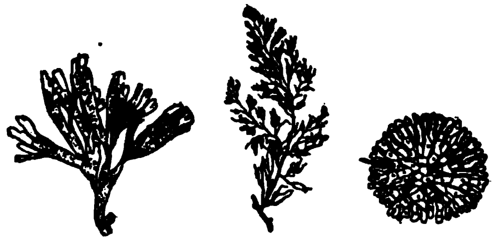

FIG. 8.— A plant of Dictyota; somewhat reduced.
FIG. 9.— Portion of a plant of Sargassum; much reduced.
FIG. 10.— A plant of Coleochæte; much magnified.

Class 12. *Cyclosporeæ*. Rockweeds. These are branching, medium sized plants, growing at or near the surface of the water, often attached to rocks between low and high water. They are exclusively marine and are found from the cold waters of the north and south Atlantic and north and south Pacific to the warm waters of the tropics. They are firmly rooted below and in some cases the plant body is differentiated into stem and leaves. No means of asexual reproduction are known. The sexual organs are formed in narrow-mouthed, almost spherical depressions (conceptacles) on the surface of the unmodified vegetative branches or of specially modified reproductive branches. The eggs are produced by eights, fours, or even singly in the oogones, escaping through the mouth of the conceptacle and there meeting the small motile sperms which have been produced in large numbers in the numerous small antherids in other conceptacles, either on the same or on another plant. The fertilized egg germinates almost immediately. There are upward of 400 species, all included in one order,

Order 28, *Fucales*, and divided among four families. The largest genus is Sargassum (Fig. 9) with about 200 species, of the warmer waters of the sea, one of which (*S. bacciferum*) is the "Gulf-weed" which floats in large quantities in the so-called "Sargasso Sea" in the mid-Atlantic Ocean. Originally, attached by its roots it has broken loose and been carried away by the Gulf Stream and other ocean currents. It floats in the water by means of its many little air bladders which occur on the petioles. Other common plants of this class are the Rockweeds, proper (Fucus), which are attached to rocks and wharves between high and low-tide marks and the Knotty Rockweed (Ascophyllum) with large bladders in its slender stems.

Phylum VI. RHODOPHYCEÆ.— The Red Seaweeds. These plants are minute to middle-sized or even large (a foot or more in length), rooted below and more or less branched above. In the simpler forms they are unbranched or branched filaments, but many form broad sheets or large and massive plant bodies. All but a few species are chlorophyll-bearing, but the green color is concealed by a red or purple pigment. The species are with very few exceptions marine. A very few species are true parasites in other seaweeds. Asexual reproduction is by means of naked, non-flagellate cells set free singly or in fours. Sexual reproduction is by the union of the nucleus from a naked, non-motile sperm with that of an egg enclosed within the oogone, the resulting cell dividing into few or many cells, some or all of which are the carpospores which give rise to the new plants. The phylum is divided into two unequal classes.

Class 13. *Bangioideæ*. Simple or branching filaments or sheets of cells. Asexual reproduction by the formation of single naked cells (monospores). Sexual reproduction by the transformation of ordinary vegetative cells into oogones or antherids. After fertilization, the oogones divide into four or eight cells (rarely not dividing) which slip out of their walls as naked, non-flagellate, amœboid carpospores. About 50 species, doubtfully divided into two orders.

Order 29. *Bangiales*. Chloraplasts single in each cell. Bangia with a dozen or more species of filamentous plants and Porphyra, "Laver," of almost 20 species are the principal genera. The last-named are flat, leaf-like, purple plants, which are very common throughout the world in salt or brackish water and are used for human food. One family only; marine.

Order 30. *Rhodochætales*. Chloroplasts several to many in each cell. Filamentous, sometimes corticated plants. Asexual reproduction by monospores; sexual reproduction not known. Two families, one marine and one fresh water. A doubtful group because of ignorance as to the sexual reproduction.

Class 14. *Florideæ*. True Red Seaweeds. This class includes approximately 3,000 species of plants, found in the seas of all parts of the world and in small numbers in fresh water as well. A few species are true parasites upon other seaweeds, and entirely colorless; others although parasitic in habit still retain some of their color. The great majority, however, are not at all parasitic. Many are edible and some are of great economic value. In this class the cells possess mostly numerous, small, disc-shaped chloroplasts and are connected to one another by plasmatic strands through the central openings in the cell wells, both being features lacking in the preceding class. Asexual reproduction is by means of monospores in a few cases, where there is no alternation of sexual and non-sexual plants. In the contrary case, however, which is the rule in nearly all species, the asexual reproductive cells are produced in fours (*tetraspores*) on one generation of plant, these producing the plants that bear the sexual organs. The latter are special cells, not merely slightly modified vegetative cells. The oogone has a long neck (*trichogyne*) and is the terminal cell of a row of three or four cells. After fertilization by the water-borne, non-motile, naked sperm the oogone sends out branches at the ends of which are produced the carpospores, or the oogone fuses with adjacent cells and from the common cell thus produced arise the carpospore threads. The carpospores produce the tetraspores plants in the species with alternation of generation.

Order 31. *Nemalionales.* The fertilized oogone grows out directly to form the carpospore-bearing threads. Many of the plants of this group occur in fresh water, e.g., Thorea (Fig. 11) which occurs as a somewhat slimy, branched, brown string, several inches long in fresh-water streams. Nemalion forms a mass of slimy, brownish threads on rocks between high and low water marks in the sea. Many species of this order show no alternation of generations and hence produce monospores instead of tetraspores.

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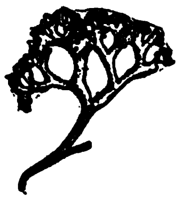
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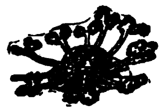
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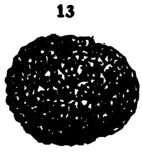
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Fig. 11.— Portion of a plant of Thorea; somewhat reduced.
Fig. 12.— A plant of Chondrus; somewhat reduced.
Fig. 13.— A fruit of Microsphæra with its branched appendages; much magnified.
Fig. 14.— A fruit of Tuber; somewhat reduced.

Order 32. *Cryptonemiales.* The fertilized oogone sends out long threads which unite with large nutritive cells in various parts of the plant and there give rise to the carpospore-bearing threads. Asexual reproduction by tetraspores. Worthy of notice is the genus Corallina, in which the plant body is very thoroughly infiltrated and encrusted with lime. The plants are jointed, being flexible at the joints which are not encrusted. The color is a delicate pink.

Order 33. *Ceramiales.* The fertilized oogone fuses with an adjacent nutritive cell, from which then the short sporogenous threads arise, the whole being mostly surrounded with a protective coat of sterile threads with an opening to permit the escape of the carpospores. Asexual reproduction is by means of tetraspores. Some of the plants of this order are filamentous, such as the very common and beautiful Ceramium species, others are more or less leaf-like, as Delesseria.

Order 34. *Gigartinales.* The fertilized oogone fuses with an adjacent nutritive cell as in the foregoing order but the filaments sent out from the latter are long and grow and branch in among the vegetative tissues of the plant. Tetraspores are formed. The plants are not filamentous but many cells thick. *Chondrus crispus,* Irish Moss (Fig. 12), forms branching, purple plants a few inches high in the waters of the North Atlantic. It is used for making blanc mange.

Order 35. *Rhodymeniales.* The nutritive cell with which the fertilized oogone fuses is not formed until after fertilization has taken place. From it grow out short sporogenous threads. Tetraspores are present in all species. Agar-agar, which is of such great importance in bacteriological work, is obtained from an East Indian species of Gracilaria, belonging to this order.

Phylum VII. Carpomyceteæ.—The Higher Fungi. Terrestrial, rarely aquatic, filamentous, branching plants with frequent cross walls, and usually, at first, but one nucleus to a cell. No chlorophyll is produced so that the plants are dependent upon organic matter produced by other organisms. Large numbers are saprophytes, i.e., they feed upon the bodies of dead organisms, or on non-living organic matter, but a vast number are parasites, some of them very destructive, upon animals or plants. Asexual reproduction is present in almost all groups and consists usually of the rounding off and setting free of terminal cells (conidia) of ordinary or special branches. These conidia offer a multiplicity of forms and colors and great variety of detail as to the location on the conidiophores and as to the shape and grouping of the latter. Sexual reproduction is known in all of the larger groups and likewise shows great variability as to detail. In common to all the groups and to the Red Seaweeds from which this phylum probably arose is the fact that the union of sexual cells or nuclei leads to the production of a mass of threads of which the terminal (or subterminal) cells produce the spores which develop into the new plants. The approximately 64,000 plants of this phylum are distributed among three classes.

Class 15. *Ascomyceteæ.* The Sac Fungi are in many respects more primitive than the other classes of the phylum. Their distinguishing feature is the production of the spores in sexual reproduction within terminal or sub-terminal, usually enlarged cells, called asci. In each ascus the number of spores produced is most often eight, although in some cases the number is higher or lower. By bursting of the ascus, the cells are ejected with more or less violence and on germination give rise to the new plants. In some of the families of this class that show the most points in common with the Red Seaweeds sexual reproduction results from the union of a non-motile, water-borne sperm with the elongated portion (*trichogyne*) of the oogone, exactly as in the Class Florideæ. As a consequence of this union there arise from the oogone numerous threads, corresponding to those producing the carpospores, the subterminal cells of which become the asci. In more plants of this class separate sperms are not produced but the antherid comes into direct union with the oogone or its extension, the asci developing, however, in the same manner. In some cases even the antherids seem to have disappeared, and the two sexual nuclei which unite both originate within the oogone. In a few very much simplified forms the oogone is also lacking and asci arise from vegetative cells, the two nuclei that develop within the ascus fusing before the spores begin to be formed. Throughout most of the group the ascus-producing threads are associated with sterile threads so as to form a small or large fruit which may be solid (Fig. 14) or hollow, with or without (Fig. 13) a definite opening, or may open out as a cup or saucer-shaped structure (Fig. 16). In the simplified forms the asci may be naked and scattered. The class contains about 29,000 species in perhaps 15 orders.

Order 36. *Laboulbeniales.* Beetle Fungi. These are minute fungi of but few cells each, parasitic in the chitinous wall of the body or appendages of beetles and other insects, particularly those of damp places. The oogone is provided with a trichogyne to which the usually naked non-motile sperms become attached. From the cell below the oogone an envelope is produced before fertilization, that completely invests it as a protective coat. The fertilized oogone gives rise to a considerable number of four, rarely eight-spored asci. Over 50 genera and more than 600 species have been recognized from all parts of the world.

Order 37. *Lecanorales.* Disc. Lichens. Fungi parasitic upon lower green and blue algæ, usually forming characteristic, variously colored, flat or erect, leaf-like or leafy stemmed structures growing on the ground, on rocks, on trunks of trees, etc. Sexual reproduction by the union of a minute, non-motile sperm with the many celled trichogyne that grows out from the oogone. The resulting threads that grow out from the oogone bear their asci in a saucer or cup-shaped structure (apothecium). Several thousand species distributed among nearly 30 families. Among them are the Reindeer Moss (Cladonia), which is the most important food for the reindeer, Old Man's Beard (Usnea) which hangs in long streamers from the branches of trees, etc.

Order 38. *Pezizales.* Cup Fungi. In this group the plants are parasites upon other plants than lower algæ or saprophytes. The asci are produced as in the preceding order in cup or saucer-shaped apothecia. In most forms, the details of sexual reproduction are unknown. In a few forms the oogone possesses a long or short trichogyne which grows over to an antherid with which its tip fuses. Antherids are sometimes lacking. Plant consisting of slender, branched, septate threads, usually inconspicuous but apothecia often showy (Fig. 16) varying in size from under a millimeter to 15 to 20 centimeters in diameter. About 10 families. The genus Sclerotinia contains several very destructive plant parasites.

Order 39. *Helvellales.* Related to the foregoing, but the apothecia more or less everted and frequently stalked. The Sponge Mushroom (Morchella) is a very delicious mushroom found in the woods in the spring. Three families.

Order 40. *Caliciales,* and Order 41, *Phacidiales,* are related to the first two orders. The former consist mostly of lichens (i.e., fungi parasitis upon lower algæ).

Order 42. *Tuberales.* Truffles. Plants subterranean, both as to vegetative and reproductive parts. The latter are up to an inch or two in diameter, more or less spherical, and apparently to be looked upon as an apothecium that is highly contorted, with but a very small opening. The common truffle (Tuber, Fig. 14) is found in oak forests in Europe. Some species occur in America.

Order 43. *Exoascales.* Fungi saprophytic or parasitic upon higher plants, with abundant or scanty, branching plant body upon which is produced a single layer of closely placed asci, forming a sort of simplified apothecium. Sexual reproduction unknown beyond the union of two nuclei in the very young asci. Two families of about 60 or more species. Species of the genus Exoascus cause several serious diseases, e.g., the destructive Leaf Curl of the peach and witches' broom of cherry, etc.

Order 44. *Hysteriales.* Slit Fungi. Wood and leaf-inhabiting fungi, as well as "lichens." The apothecium is very much elongated so that its opening forms a slit. Among the "lichens" is Rocella from which the pigment litmus is obtained. The genus Hysterographium (Fig. 15) is common on twigs of ash and other trees. Perhaps seven families.

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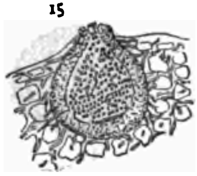

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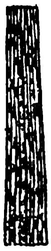

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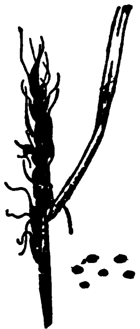

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FIG. 15.— A dead stick with black fruits of Hysterographium; slightly reduced.

FIG. 16.— Several fruits of Peziza; slightly reduced.

FIG. 17.— Part of a grass leaf with a Rust (Puccinia) upon it; slightly reduced.

FIG. 18.— Head of wheat affected with a Smut (Ustilago); somewhat reduced.

FIG. 19.—A verticle section through the fruit of Phyllosticta; much magnified.

Order 45. *Pyrenulales.* Closed Lichens. Parasitic on lower algæ. Asci produced in a more or less spherical hollow body (perithecium) with a small apical opening. Twelve or so families of usually small lichens.

Order 46. *Sphæriales.* Black Fungi. Saprophytes or parasites, but not parasitic on algæ (i.e., not "lichens"). Closely related to the foregoing order, possibly to be united with it. Asci produced in more or less spherical hollow bodies (perithecia) with small apical openings (ostioles). Perithecia black and rather brittle; separate, or crowded together, or united by a special fungal mass (*stroma*). Sexual reproduction studied only in a few forms. Oogones provided with trichogyne in some genera, without it in others; separate, non-motile sperms apparently produced in some forms, the oogone and antherid uniting directly in others. More than 6,000 species in 18 or more families. The species of this group are largely found on wood or on living or dead herbaceous stems or leaves. Many of the more important plant diseases are due to their activities; e. g., Black rot of grape due to Guignardia, Scab of apple and pear caused by different species of Venturia, Bitter Rot of apple and many other plants caused by Glomerella, and Chestnut Blight caused by Endothia.

Order 47. *Dothideales.* This order is closely related to the foregoing one from which it differs in that the asci are borne within cavities in a stroma without a special perithecial wall of their own. The nearly 800 species, representing 140 genera and four families, are found in most parts of the world but are especially abundant in the Tropics. They are, practically without exception, parasites in herbaceous stems and in leaves. The Elm Leafspot which causes the premature falling of elm leaves in Europe is caused by a species of Systremma. More than 300 species of Phyllachora are known, among them the common *Phyllachora graminis* on various grasses.

Order 48. *Hypocreales.* The several hundred species of this order show great similarity to the two foregoing orders, differing principally in the rather bright color and fleshy or leathery consistency of the perithecium or stroma. Many are saprophytes but a number of dangerous parasites occur on plants, e.g., Nectria, causing cankers on limbs of apple; Spermœdia (Claviceps) causing Ergot of rye and other grasses.

Order 49. *Perisporiales.* Mildews. Superficial fungi, mostly parasitic. Asci arising from the base in small closed perithecia, following direct union of antherid with oogone which possesses no trichogyne. Two, possibly three, families of which one (*Erysiphaceæ*) contains many important plant parasites, e.g., Microsphæra (Fig. 13) the cause of the Powdery Mildew of lilac; Sphærotheca, which, when introduced from America into Europe, proved so destructive to the gooseberry; Uncinula, which had a similar history with regard to the European grape.

Order 50. *Aspergillales.* Molds. The many hundred fungi making up this order are very largely saprophytes although a number are parasites of economic value. None are parasitic on algæ. They are mostly well provided with means for asexual reproduction, sometimes the sexual type being produced only rarely. The asci are produced within more or less spherical, closed, solid bodies, being scattered through the mass of the tissue (not basal in a cavity as in the Perisporiales). In a number of cases the union of antherid with the oogone has been observed. The fruits are mostly minute but in two families are large and subterranean. The common Blue Mold (*Penicillium*) is found in damp climates as a destructive mold on shoes and other leather goods; other species are essential to the production of Roquefort cheese; some are parasitic within the ear of man. Thielavia causes a serious root disease of tobacco and other plants.

Order 51. *Saccharomycetales.* These plants show the greatest degree of simplification in this phylum. The plant body may consist of elongated branching threads, or, in many cases, the cells may separate soon after cell division so that one-celled forms result. Even the filamentous forms resolve themselves into the other type under special external conditions. The asci are not formed within any special structure but arise on the filamentous forms as scattered lateral outgrowths, either without, or as a result of, the union of almost similar antherid and oogone. The one-celled forms (yeasts) may become converted directly into asci, with or without previous union of two cells. The most important family of this order is that of the Yeasts, of which the genus Saccharomyces is most important. The common yeasts have been cultivated from time immemorial for the leavening of bread and also for the production of alcoholic beverages.

Class 16. *Teliosporeæ.* Brand Fungi. Long, branching, septate fungi, parasitic within the tissues of higher plants, which are often very seriously injured by them. Asexual reproduction by various types of non-septate conidia. Sexual reproduction consisting of the union of adjacent cells to form binucleate cells. The uniting cells may be definitely located or the union may consist in the division of the nucleus of a cell and the failure of the cytoplasm to divide. The process may occur at various points of development, depending upon the form. The binucleate cells by division give rise to filaments of similar cells. Eventually thick-walled binucleate spores (*teliospores*) are formed in various ways, the two nuclei fusing when the spore is still young. After a short or long resting period, or immediately, in some cases, this teliospore gives rise to a short filament (*promycelium*) upon which are produced four (sometimes more) uninucleate spores (*sporidia*) which serve to infect the new host plant. Over 4,000 species divided among two orders.

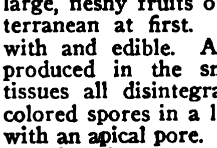
Order 52. *Uredinales.* Rusts. The fungi composing this order are among the worst plant parasites of cultivated crops, as well as of innumerable wild plants. Typically, there are five spore forms: (1) teliospores, giving rise to a four-celled promycelium bearing on each cell a (2) sporidium. This produces a fungal growth within a suitable host plant which produces the (3) pycniospores, which appear to be functionless sperms, and the (4) æciospores. There is a sexual union of adjacent threads before this process so that these spores are binucleate. They give rise, in the proper host plant, to a septate branched thread with binucleate cells. From this arise the (5) urediniospores, also binucleate, and later the (1) teliospores. The urediniospores produce a growth exactly like that from the æciospores. They are properly called repeating spores because they do not introduce a different generation. Complications are very numerous, in that many rusts have this latter stage on one kind of host plant and the stage that produces the pycniospores and æciospores on another host. Again, some rusts have no urediniospores and in still others the æciospores also are not produced. The teliospores vary greatly in appearance. Among the better known rusts are the Black Rust of small grains, which has its pycnial-æcial stage upon the common and purple barberry, and its other stages on the small grains and various other grasses (Fig. 17); White Pine Blister rust with its destructive pycnial-æcial stage on the white pine and the other stage on currants and gooseberries; Apple rust, with its destructive pycnial-æcial stage on apple and the telial (there is no uredinial stage) stage on red cedar. Probably 3,000 or more species in three or four families.

Order 53. *Ustilaginales.* The Smuts. These are also widespread as destructive parasites of cultivated and wild plants. The teliospores are usually produced as a powdery mass, within the tissues of the host plant, often totally destroying portions of the plant and thus being set free as a dark-colored dust. There is not the complicated life history that the previous order possesses. The promycelium from the teliospores produces sporidia which may infect the host at once or which may give rise to a saprophytic growth on decaying organic matter in the soil, producing numerous small conidia which are capable of infecting the host plants. The young teliospores are binucleate, as are the cells from which they arise, but there is no strict alternation of generations with uninucleate and binucleate cells as in the Rusts. The 1,000 or more species are divided into two families. Among the more destructive parasites are the Loose Smut of wheat (Fig. 18) and the smuts of oats and corn, caused by species of Ustilago, Stinking Smut of wheat caused by Tilletia and several others on rye, barley, sorghum, etc.

Class 17. *Basidiomyceteæ*. In this vast class of about 14,000 species and perhaps nine orders, sexual reproduction has reached almost its lowest ebb. There seems to be no definite union of antherid and oogone at any definite point. By the failure to produce a cross wall, a dividing cell becomes binucleate and thus initiates a series of binucleate cells. Eventually the terminal cells of such threads enlarge, the nuclei fuse and a basidium results. From this bud out four (in some cases more or less) basidiospores, which start the new plants. The basidia are produced on surfaces either within a closed fruit or exposed to the air; in the former case the fruit opens in some way (sometimes only by decaying) to permit the spores to escape, in the latter they are set free directly into the air. The fruits are mostly of good size, from a few millimeters up to a foot or more in diameter.

Order 54. *Hymenogastrales,* and Order 55, *Sclerodermatales,* consist of fungi growing in the soil and producing their moderate-sized fruits below the surface, although they may emerge at maturity. The basidia are produced within the fruits. Unimportant groups.

Order 56. *Lycoperdales*. Puff Balls. The large, fleshy fruits of this order are often subterranean at first. They are fleshy to begin with and edible. After the spores have been produced in the small, sinuate cavities, the tissues all disintegrate, leaving the dry dark-colored spores in a large central cavity, usually with an apical pore. On logs and on the ground are found numerous species of Lycoperdon (Fig. 22), the Giant Puff Ball (Calvatia), found on lawns and meadows, sometimes reaches a diameter of 18 inches or more. The little Earth Stars (Geaster) also belong here, being puff balls whose outer coat splits down longitudinally, turning out so as to form a star-like figure.



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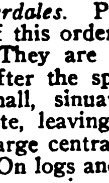

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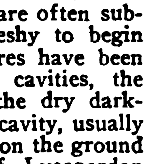

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Fig. 20.— A vertical section through the fruit of Glœosporium; much magnified.

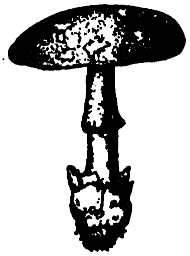
Fig. 21.— Several spore-bearing threads of Ramularia; much magnified.

Fig. 22.— A fruit of a Puff Ball (Lycoperdon); somewhat reduced.

Order 57. *Nidulariales*. Bird's Nest Fungi, whose dainty little cup or beaker-shaped fruits, containing a number of egg-like bodies, are found on the ground or old sticks, are few in number as to species, but widespread as to distribution.

Order 58. *Phallales*. Stink Horn Fungi. The fruits of the usually terrestrial fungi of this order are fleshy and produce their spores internally as in the foregoing orders. Their escape is furthered by the rupture of the fruit and the deliquescence of the sporogenous tissue into a foul-smelling slime which attracts the carrion-loving flies which serve to distribute the spores. The common Stinkhorn (Phallus) is found the world over.

Order 59. *Agaricales*. In this order which contains most of the commoner fungi of this class, the fruit is from medium size to large. The basidiospores are produced on basidia which line surfaces exposed to the outer air so that as the spores fall they are carried off by the wind and do not have to await some process by which an opening is made, as in the foregoing orders. The order has about five families, all of them world-wide in their distribution. Best known are the toadstools, in which the basidium layer occupies the surfaces of the radiating gills. These umbrella-shaped fruits (Fig. 23) are familiar to everyone. Of the 6,000 or more species of toadstools a few are deadly poisonous, more are mildly so, and the vast majority are harmless. One species (*Agaricus campestris*) is cultivated the world over in temperate climates. Numerous other species are collected regularly as they appear in the wild state. Most toadstools grow on decaying vegetable matter in the soil, but some are wood destroyers; a few even attacking living trees. The Pore fungi, on the other hand, are mostly wood inhabitants, causing the decay of the heart wood in some cases; of the sap wood in others or of both. They may attack only dead trees or may grow only on living trees. They contain some of our most dangerous timber destroyers. Mostly their fruits are bracket or hoof-shaped, growing out from the side of the tree or timber, within which the richly branched, septate threads of the fungus are spreading. On the under side of this fruit are minute pores which, like the gills of the toadstools, are lined with the



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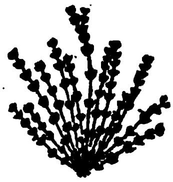

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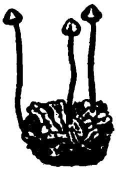

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Fig. 23.— A fruit of a Toadstool (Amanita); somewhat reduced.

Fig. 24.— A plant of a Stonewort (Chara); considerably reduced.

Fig. 25.— A Liverwort (Grimaldia) of the thallose type; somewhat reduced.

basidia. Among the more widely distributed fungi of this family are various species of Fomes and Polyporus. In another family of the order, the basidia line teeth or prickles that hang from the under side of the fruit (Hydnum) while in still other families the smooth surface of the fruit bears the layer of basidia (Corticium). Most of the members of these latter families are also wood destroyers, but few are found on any but already decaying logs, sticks, etc. One species of Corticium, however, is a destructive root parasite of potato, beet and many other cultivated crops.

Order 60. *Exobasidiales.* The basidia in this order are like those of the preceding one, club-shaped, with the four basidiospores arising from the rounded top. The fungus itself grows inside the herbaceous portions of living plants, breaking through the epidermis to form a single layer of basidia on the outside. There is no distinct fruit, other than this layer of basidia. The genus Exobasidium contains a harmful parasite of the cranberry.

Order 61. *Tremellales.* Jelly Fungi. These are mostly wood or ground inhabitants. The fruits are of moderate size and cushion-like or lobed in various ways. When wet, they are soft and jelly-like; when dry, very inconspicuous, dark, hard masses, of greatly reduced size. The basidia are split down lengthwise into four cells, each bearing on a long stalk a single basidiospore.

Order 62. *Auriculariales.* Ear Fungi. These resemble the foregoing order greatly in general habit, gelatinous nature of the fruit, etc. The essential difference is that the basidia are elongated and divided transversely into four cells, from each of which a stalk arises, bearing a single basidiospore. The common Jew's Ear (Auricularia) is very common as a brown, ear-shaped fungus on branches of trees.

The *Imperfect Fungi* constitute a group of fungi containing neary 17,000 species. They form in reality only an artificial group of heterogeneous species. Their sexual reproduction is unknown and they are grouped accordingly only by their modes of conidium formation or where no kinds of reproductive spores are known by their vegetative structures. As they are studied carefully, many of them are being found to be merely conidial or vegetative stages of fungi that belong to the class Ascomyceteæ or less often to the Basidiomyceteæ. It is possible that some of them are fungi that have utterly lost their sexual reproduction and reproduce now only asexually. In such a case, their exact kinship cannot be determined and they will have to remain in this group of Imperfect Fungi. For the sake of convenience, the fungi in this group are, so far as they reproduce by spores, distributed among three orders.

Order 63. *Sphæropsidales.* The conidia are produced within more or less rounded protective bodies (pycnidia) usually with an opening for the spores to escape. These fungi include some troublesome parasites of plants, e.g. -- Phyllosticta (Fig. 19) which causes leaf spots on various plants, Septoria, the cause of Leaf Spot of Tomato, etc.

Order 64. *Melanconiales.* The conidia in this group are produced on rather short threads that are closely crowded side by side, usually underneath the epidermis of the host plant. They accumulate in such numbers as to burst the epidermis and allow them to exude a sticky mass. Here we have numerous species of Glœosporium (Fig. 20).

Order 65. *Moniliales.* Molds. The spores in this group occur neither in rounded bodies (pycnidia) nor in packed threads under the epidermis (acervuli) but on more or less separate threads which emerge from the object on which the mold is growing in various ways. In Ramularia (Fig. 21) and Cercospora we have numerous parasites of leaves, the elongated conidia arising from short or elongated threads that emerge from the stomata of the host epidermis. Botrytis causes many diseases, as on onion, peony, lily, etc. Many species of Fusarium attack the potato.

Phylum VIII. BRYOPHYTA.— Mossworts. The plants of this phylum are all massive, in contrast to the filamentous structures generally found in the preceding phyla, being composed of many layers of cells, which are aggregated into flat bodies (*thalli*) or leafy stems. They are typically terrestrial, although in the lowest family some species are still aquatic, while others have come out a little distance from the water upon the wet earth. All of the species are chlorophyll-bearing and none are either parasitic or saprophytic. Their reproduction is mostly sexual. The egg cell is invested from the first with a long-necked envelope, the archegone, which opens at the apex to permit fertilization. The antherids are compound, consisting of many small, cubical cells (each an antherid proper and producing a single sperm) surrounded by an enclosing layer of larger cells. The sperms are spirally curved and provided with two long flagella. After fertilization (which must take place in water, as in a rain drop) the egg divides repeatedly and gives rise to a globular or elongated cellular structure, some of whose interior cells ultimately divide internally into four spores each. The spores on escaping germinate and eventually give rise to new plants. The asexual reproduction, which is lacking in some species, is as follows: Upon some part of the plant, single cells (brood cells) or masses of cells (brood masses), grow on the ends of short hairs, and, falling off, grow directly into new plants. There are two classes.

Class 18. *Hepaticæ.* Liverworts. These are mostly supine, flat plants, attached to the ground by root hairs for nearly their whole length. By the deeper and deeper lobing of the margins of the thallus we find all gradations up to a leafy stem, with the leaf planes parallel to the stem axis. Such leafy stems are as distinctly two-sided (dorsiventral) as the undifferentiated thalli from which they are derived. There are about 4,000 species of liverworts, which may be arranged in three or four orders.

Order 66. *Marchantiales.* (Fig. 25). In this order are aggregated those liverworts in which the plant is thallose and the fruits indehiscent or dehiscent only by irregular or regular terminal openings. The antherids and archegones are on the upper side of the plant or the archegones apparently on the under side of special stalked receptacles. There are three families, the first of which, the Crystalworts (*Ric-*

ciaceæ), includes small, radiate, thallose plants, half an inch or so in diameter, floating on the water or growing on the wet earth. The antherids and archegones are sunken in the upper surface of the plant body. The fruits are spherical, stalkless and indehiscent and remain enclosed in the archegonial wall. Except for the outer layer of cells the whole fruit consists of spores. Riccia and Ricciocarpus are common. The Great Liverworts (*Marchantiaceæ*) are larger and dichotomous-spreading upon the ground. The thallus is ribbed in its longitudinal axis. The fruit, which is short-stalked, breaks open more or less irregularly at its apex and sets free the spores which are intermingled with elongated, sterile cells, the elaters. The archegones and frequently also the antherids are often produced on stalked portions of the thallus, the receptacles, as in Marchantia and Grimaldia (Fig. 25).

Order 67. *Anthocerotales.* Horned Liverworts. These are thin, flat, thallose plants having their antherids and archegones embedded in the upper surface. After fertilization, the egg develops into an elongated, somewhat club-shaped stalk, containing a large amount of assimilating tissues and a central "columella," the spores, intermingled with elaters being formed in the rather limited space between. This fruit may continue to grow at the base after the spores are ripe at the tip where it splits lengthwise into two valves to set the spores free. In this family, particularly in the genus Anthoceros (Fig. 26), the fruit (henceforward called sporophyte in the higher groups) is only partially dependent upon the thallose parent plant, obtaining water and mineral matters from it but manufacturing for itself most of the organic foods it requires for the nourishment of the spores.

Order 68. *Jungermanniales.* The Scale Mosses (Fig. 27) are leafy stemmed (or their simplest forms thallose) plants with their fruits (sporophytes) split vertically into four segments, setting free the spores and elaters. These little plants are frequently mistaken for mosses, which they resemble in external appearance. They grow commonly on trees, stones and sometimes on the ground. The more than 135 genera and 3,600 species may be divided into two families. The genera Jungermannia and Plagiochila (Fig. 27) are common in many parts of North America.

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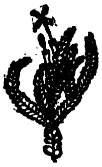
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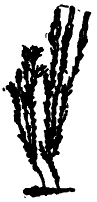
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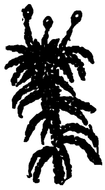
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FIG. 26.— Fruiting plant of a Horned Liverwort (Anthoceros); slightly reduced.

FIG. 27.— A Scale-moss (Plagiochila) in fruit; about natural size.

FIG. 28.— Branches of a Black Moss (Andreæa); somewhat magnified.

FIG. 29.— Portion of a Peat Moss (Sphagnum) in fruit; slightly reduced.

Class 19. *Musci.* Mosses. These are leafy-stemmed, terrestrial, rarely aquatic plants, usually erect and attached to the ground by root hairs on the lower part of the stem. The leaf planes are approximately at right angles to the stem axis and the leaves are usually in many rows, alternate and crowded, only rarely in two rows. The antherids and archegones are at the summit of the stem, sometimes together, oftener on separate shoots or plants; or at the ends of short lateral shoots. The fruit (sporophyte) resulting from the growth of the fertilized egg may develop a long stalk (as in most mosses) or be short stalked or almost stalkless. In the latter cases, however, the parent stem may grow out into a stalk (pseudopodium) which is not part of the sporophyte. The main portion of the sporophyte is enlarged and contains externally and internally considerable sterile tissue with an intermediate layer of sporogenous tissue. Mostly this "capsule" dehisces regularly, by slits or by the falling off of a lid. The spores on germinating produce a mass of green branching filaments (protonema) or a flat thallus, from which later the leafy stems bud off. There are over 12,000 species which may be arranged in three orders.

Order 69. *Andreæales.* The Black Mosses (Fig. 28) are small, leafy, dark plants, usually growing on rocks. Their leaves are thickish and composed of uniform cells. The sporophyte is raised on a stalk (pseudopodium) of the leafy plant itself. It opens to permit the escape of the spores by four or eight longitudinal slits. The protonema is thallose. The single genus Andreæa contains over 100 species.

Order 70. *Sphagnales.* The Peat Mosses (Fig. 29) are large, leafy, pale-green plants growing in bogs. Their leaves are thick and are composed of dissimilar cells, some containing chlorophyll and others with perforated walls so as to admit water freely. The sporophyte is raised on a pseudopodium and is itself short-

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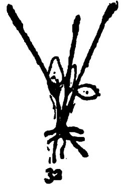
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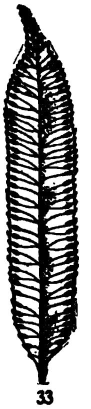
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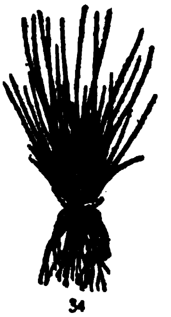
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FIG. 30.— Plant of a Sac Moss (Archidium); somewhat enlarged.

FIG. 31.— One of the True Mosses (Bryum) in fruit; somewhat reduced.

FIG. 32.—An Adder-tongue Fern (Ophioglossum); considerably reduced.

FIG. 33.— A spore-bearing leaflet of a Ringless Fern (Marattia); considerably reduced.

FIG. 34.— Plant of a Quillwort (Isoetes); somewhat reduced.

stalked. It opens by a circular lid to permit the escape of the spores. The protonema is thallose. There is but one family, containing the single genus Sphagnum, with over 250 species. These are found over nearly the whole world. They are highly esteemed by gardeners for packing plants, on account of their power of retaining moisture for a long time. Some species possess great value for surgical dressings.

Order 71. *Bryales*. The True Mosses (Figs. 30 and 31) are small to large plants, exceedingly variable as to habitat; they are found on trees, on the ground, on rocks and a few species in water. Some form large cushions a foot or more in diameter and several inches thick, while others are scattered and but a few millimeters in height. The leaf cells are all more or less similar and chlorophyll-containing. With a very few exceptions the sporophyte is long-stalked and the capsule is usually dehiscent by a circular lid. In the family *Phascaceæ* the capsules of the minute plants are short-stalked and indehiscent; but in the remaining families of the order the capsule develops a lid which on falling off reveals an opening usually provided with a fringe of teeth in one or two rows. These may number 4, 8, 16, 32 or 64 and constitute the «peristome.» The protonema is typically filamentous. The 12,000 or more species are divided among nearly 60 families. Among the commoner mosses are Phascum, Orthotrichum, Funaria, Bryum (Fig. 31), Mnium, Polytrichum, with sporophytes terminal to the main stem, and Fontinalis (an aquatic form), Neckera, Leskea, Climacium and Hypnum, with sporophytes arising from short lateral shoots.

Phylum IX. PTERIDOPHYTA.— Ferns. The plants of this phylum present a distinct alternation of two generations, gametophyte and sporophyte, respectively. The gametophyte is a small thallose plant resembling the simpler liverworts and bears antherids and archegones of the same plan as in those plants. The sperms are spiral and multiciliate. The fertilized egg develops into a multicellular structure which is at first enclosed within and dependent upon the gametophyte, but which soon develops roots, stem and leaves of its own and attains complete independence of the parent gametophyte. This sporophyte has true vascular bundles. It does not develop its spores until it has reached a comparatively large size. The leaves are mostly large and broad, and are clustered near the apex or scattered along the stem, but never in whorls. The stem is solid and upright or horizontal, in most forms subterranean. In contrast to the Bryophyta the sporophyte is the long-lived generation while the gametophyte persists only until the former has established itself independently. In further contrast the sporophytes of Pteridophyta develop only a relatively small part of their cells into spores. These are produced in small «sporangia» which may originate within the tissues of the plant or as external structures, always as parts of leaves. These leaves are mostly not different from the vegetative leaves, although in some species the «sporophylls» are much differentiated. Asexual reproduction occurs in a few species by the formation of little bulblets on the leaves. About 3,800 species are recognized, distributed very unequally in two classes.

Class 20. *Eusporangiatæ*. This class contains only a small number of existing species, but seems in the Paleozoic era to have been very numerously represented. Its chief distinction lies in the development of the sporangia from internal cells of the leaf. Three orders may be recognized.

Order 72. *Ophioglossales*. Adder-tongue ferns. The gametophytes of this order are subterranean and tuberous; the sporophyte possesses short, subterranean stems and usually but one leaf at a time. This is simple or compound. The spore-bearing leaves are divided into a spore-bearing and vegetative part. The chief genera of the single family are Ophioglossum (Fig. 32), the adder-tongue fern, and Botrychium, the grape fern.

Order 73. *Marattiales*. The Ringless Ferns have flat, green, liverwort-like gametophytes and large-leaved, thick-stemmed sporophytes, the leaves on some species reaching a length of 10 to 15 feet. The sporangia are formed on the dorsal side of the leaf, arising within the leaf but growing so as to project prominently. In most of the few genera the crowded sporangia are united into compound structures called «synangia.» All the species are tropical. Marattia (Fig. 33), Angiopteris and Danæa are grown in the larger conservatories.

Order 74. *Isoetales*. The Quillworts. The sporophytes of this order are plants from an inch to a foot in height, rooted in the mud in or near the water of shallow ponds and ditches. The stem is very short and sheathed by the broad bases of the narrow, pointed leaves. The single sporangium is borne near the base on the upper side of the leaf. Two kinds of spores are produced in separate sporangia; megaspores and microspores, the former large and less numerous, the latter small and very numerous. Both sorts may be produced on the same plant, the megaspores on the outer leaves, the microspores on the inner. The gametophytes are accordingly of two kinds, each retained within the spore wall; megagametophyte, producing archegones, and, after fertilization of the egg, nourishing the embryo sporophyte and microgametophyte, reduced to but one vegetative cell and one antherid producing four multiciliate, spiral sperms. The single genus Isoetes (Fig. 34) contains about 60 species.

Class 21. *Leptosporangiatæ*. This class is distinguished by the mode of origin of the sporangia, which arise from the superficial cells of the leaves, usually dorsally, and mostly are stalked. They are grouped into characteristic groups (sori) which usually have a definite protective covering (indusium) when young. There are two orders.

Order 75. *Polypodiales*. Common Ferns. Spores of but one kind are produced so that the gametophytes are also all alike, usually with both antherids and archegones on the same individual. Sporohytes with large, usually compound leaves, with prostrate, underground stem or with stem vertical and very short, or even tree-like in dimensions. Of the eight families into which the 3,500 or more species are distributed the very great majority are found in the *Polypodiaceæ*. Among the genera common in North America are Polypodium, Dryopteris, Asplenium, Adiantum, Pteridium, Woodsia (Fig. 35), etc.

Order 76. *Marsiliales*. The Water Ferns either root in the mud in or near the water or float free on the surface. The sporophylls are folded together to form a closed «sporocarp» in one family, while in the other the indusium is indurated and completely encloses the sorus. The spores are of two kinds as are accordingly the gametophytes. Marsilia (Fig. 36) resembles a four-leaved clover. It roots in the mud. Salvinia (Fig. 37) and Azolla are floating plants and have no resemblance to the common ferns, to which they are, however, evidently related.

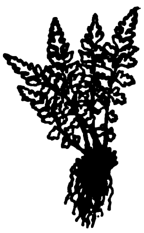
Phylum X. Calamophyta.— The plants of this phylum that survive are only about 25 in number, but these are the remnant of a large group of three distinct classes and as many orders, that flourished in Paleozoic times. The gametophytes are known only from the modern representatives of the phylum. They are flat and liverwort-like, producing antherids and archegones and multiciliate sperms, all essentially like those of the Pteridophyta. The sporophyte consists of cylindrical stems, jointed at the nodes where the leaves arise in whorls. If branched, as is frequently the case, the branches arise in whorls also. The ancient plants were both arboreal and herbaceous, but the modern survivors are all herbaceous.

In some forms the stem was solid but in others hollow. The sporangia are borne on modified leaves collected into a terminal cone. In one class there were two kinds of spores; in the others but one kind.

Class 22. *Sphenohyllineæ.* The Wedge-leaved Calamites were herbaceous and woody plants of Paleozoic times with solid, jointed stems and whorls of wedge-shaped leaves. The spores were of only one kind (isosporous). Long since extinct. One order.

Order 77. *Sphenophyllales.* Characters of the class.

Class 23. *Equisetineæ.* Horsetails. These are herbaceous plants extending from the Paleozoic to the present era. The stems are hollow and jointed and the leaves are united at their bases to form a sheath at each joint, with a tooth to represent the reduced blade of each leaf. The sporophylls are shield-shaped and produce but one kind of spore.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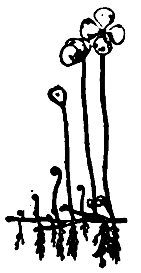
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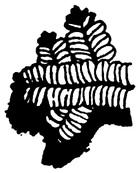
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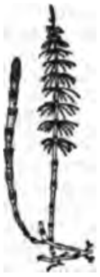
Fig. 35.— Plant of one of the True Ferns (Woodsia); much reduced.

Fig. 36.— Plant of a Water Fern (Marsilia); considerably reduced.

Fig. 37.— One of the Floating Ferns (Salvinia); considerably reduced.

Order 78. *Equisetales.* This order with but one family and one surviving genus (Equisetum, Fig. 38) is found in all parts of the world except the cold regions. Their stems are green and in some species the epidermis is so filled with silica that they were formerly used for scouring cutlery, whence the name «scouring rush.» They are frequently known as «joint rushes.»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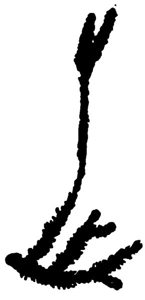
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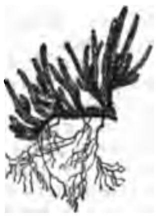
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Fig. 38.— Plant of a Horsetail (Equisetum), green plant at the right, pale spore-bearing plant at the left; much reduced.

Fig. 39.— Part of a Ground Pine plant (Lycopodium), with spore-bearing cones; much reduced.

Fig. 40.— Part of a Little Club Moss plant (Selaginella), with many spore-bearing cones; somewhat reduced.

Class 24. *Calamarineæ.* The Calamites were Paleozoic plants, long extinct, forming trees with woody stems which were hollow and capable of increasing in thickness. In their terminal cones, most of them produced two kinds of spores (heterosporous), hence it must be that the gametophytes were also of two kinds.

Order 79. *Calamariales* is the only order recognized, with two families.

Phylum XI. Lepidophyta.—The Lycopods are represented now by about 700 species of herbaceous plants, but in Paleozoic and succeeding ages immense trees occurred whose remains form part of the coal deposits in various parts of the world. The sporophytes of all forms possess solid stems, sometimes unbranched, more often branched and clothed by scale or needle-like, spirally arranged, overlapping leaves. The leaves in the modern forms are green and functional. The spores are borne in sporangia which are produced singly in the axil or on the upper surface of the sporophylls. The latter are more or less similar to the vegetative leaves and grouped into a terminal cone. The gametophytes are known for only a part of the living forms and for very few of the fossil ones. The sperms are spiral and possess two long flagella, resembling those of the Bryophyta instead of the Pteridophyta or Calamophyta. The embryo sporophyte is nourished for a considerable time within the gametophyte tissues. Two classes may be distinguished.

Class 25. *Lycopodineæ.* Lower Lycopods. These are only known in their modern forms, the fossil ancestral forms being entirely wanting. The sporophytes are herbaceous, evergreen, mostly trailing plants, sending up cone-bearing stems here and there. The spores are of but one kind. The gametophytes are more or less tuberous and sometimes underground. They bear antherids and archegones on the same gametophyte.

Order 80. *Lycopodiales.* One, or doubtfully two, families. The chief genus is Lycopodium (Fig. 39), of economic value as a source of Lycopodium powder and of the «Ground Pines» so extensively used for Christmas greens.

Class 26. *Lepidodendrineæ.* The Higher Lycopods consisted so far as fossil records go of trees and of herbaceous plants; their modern representatives are entirely herbaceous. They are in general like the foregoing class but differ in that the leaves and sporophylls possess a scale-like process on the upper surface, the ligule, and the spores are of two kinds. The gametophytes are contained within the spore walls and possess no chlorophyll. In the microgametophyte there is but one vegetative cell and the antherid is single, producing but few sperms. The megagametophyte begins to form long before the sporangium reaches maturity and opens. In some fossil species this development proceeded so far that the archegone was fertilized while the megagametophyte was still retained in the sporangium — the beginning of seed production.

Order 81. *Selaginellales.* The Club Mosses are the modern representatives of this once very important class. They are small, mostly inconspicuous, moss-like, evergreen plants, resembling miniature ground pines. The single genus Selaginella (Fig. 40) contains about 500 species, mostly tropical, but a few occurring throughout the United States and in Canada. A few species are grown in greenhouses.

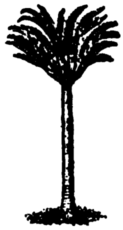
Order 82. *Lepidodendrales.* Extinct, Paleozoic and Mesozoic plants; mostly trees, with woody stems, capable of increasing in thickness. Four or five families. Some of these plants formed very tall trees.

Phylum XII. CYCADOPHYTA.— Although rudimentary seeds were formed, apparently, in one or two long since extinct genera of the Phylum Lepidophyta, the Cycadophyta were the first group in which seeds were regularly developed. The gametophytes are of two kinds, corresponding to the two kinds of spores. The microspores are wind carried. Even before they leave their microsporangium they begin to develop into the microgametophyte. This is at first contained within the spore wall and consists of a vegetative portion of one to several cells and a single antherid. The four megaspores are produced within a very large megasporangium surrounded by a protective "integument" which grows up around it from the base, entirely enclosing it except for a small apical opening, the micropyle. One megaspore enlarges at the expense of the other spores and then, within the megasporangium, produces a many-celled megagametophyte in which arise several archegones. The wind-borne microspore (or rather young microgametophyte) that happens to fall into the micropyle of the integument appears in some of the fossil forms to have enlarged in size and set free numerous sperms, in other fossil forms and all modern ones it sends out a tubular outgrowth to be regarded as an extension of the antherid which roots itself in the tissues of the megasporangium and thus obtains nourishment. Within this antherid are produced two to many ovoid, multiciliate sperms which escape and swim to the archegones which have been exposed by the breaking down of the intervening megasporangial tissue. The fertilized egg produces an embryo sporophyte which lies wholly within the megagametophyte and is nourished by it. After it had reached a certain size its growth stops, the integuments harden and the whole megasporangium falls off as a mature seed. Under favorable circumstances the embryo sporophyte then resumes its growth and emerges from the seed, or as we say, the seed germinates. The sporophytes in this phylum are all woody, some with underground stems, others with erect stems, unbranched or branched, forming large trees in many cases. In the lower classes the leaves are fern-like or at least large and pinnate; in their higher forms they are long and narrow or medium-sized and fan-shaped, always with numerous longitudinal veins. The sporangia are borne on the under side or edges of scarcely or much modified leaves which may be scattered among the vegetative leaves or grouped into cones.

There are somewhat over 100 species of this phylum now existent, representing two out of the four classes. Many more species, in all four classes, were present in Paleozoic and Mesozoic times. Indeed, the present species represent but meagre remnants of a once dominant vegetation.

Class 27. *Pteridospermeæ,* with the single order 83. *Lyginopteridales.* Seed Ferns. This group is only known from fossils of the Paleozoic era. The plants were woody stemmed with secondary thickening, and fern-like as to foliage. The microspores were borne in sporangia similar in structure and location to those of the Order Marattiales in the Phylum Pteridophyta. The megaspores were borne in sporangia terminal to the lobes of unmodified or considerably modified leaves.

Class 28. *Cycadineæ.* Cycads. Only one order (Order 84, *Cycadales*) is now represented, confined to the tropical and sub-tropical parts of the world. These are plants with erect, woody, little branched stems (occasionally subterranean), with terminal clusters of large, thick, pinnate leaves. The two kinds of sporophylls are produced on separate plants, in ter-



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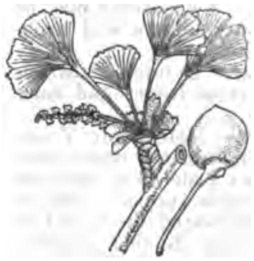

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FIG. 41.— Plant of a Cycad (Cycas); greatly reduced.
FIG. 42.— Leaves and microsporophyll cone of Ginkgo (at left), and naked seed (at right); considerably reduced.
FIG. 43. — Pine-tree (Pinus); very much reduced.

minal cones. They are much smaller and entirely unlike the vegetative leaves in the male (microsporophyll) cones and in the female cones of all but one genus (*Cycas*) in which the loose terminal cone resembles a cluster of stunted leaves with seeds borne at the edges of the lower parts of the rachis. The development of the male gametophyte and of the sperms has been fully worked out in this group. The genus Cycas (Fig. 41) is frequently grown in large greenhouses. Zamia occurs in Florida and in the tropics. It is used as a source of starch.

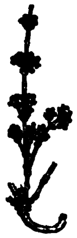
Class 29. *Bennettitineæ*. The single order of this class (Order 85, *Bennettitales*) contains many species of Mesozoic plants resembling vegetatively the plants of the foregoing class (*Cycadineæ*). They differ in that the microsporophylls and megasporophylls are present in the same cone. These cones are lateral, axillary to the leaves, and numerous. They are surrounded at the base by large leaves comparable in position to the sepals and petals of a Magnolia flower. Above these are the microsporophylls, many in number and much divided, like fern leaves, bearing at the extremities of the divisions the microsporangia. Above these, occupying the centre of the «flower» are numerous simple megasporophylls, reduced to a stalk terminated by a megasporangium, and intermingled with sterile bracts. The seed is like that of the preceding order. The chief genus is Bennettites. The plants have great interest because of the light they throw on the probable ancestry of the Flowering Plants (Phylum XIV).

Class 30. *Cordaitineæ*. The trees which make up this class were often very large, so far as they are known. The trunk was usually branched, the ultimate branches being clothed with the leaves, giving the plants a tufted appearance. The leaves were thickish and parallel-veined, in some cases fan-shaped, mostly, however, long and narrow. The microsporophylls occur in small cones; the megasporophylls in imperfectly understood, complex cones. The seeds are of the same general type as in the two foregoing phyla and were in all probability, as is the case in Ginko (Fig. 42), fertilized by motile sperms, either set free directly from the microgametophyte or (as in Ginko) from a long tube produced by it. Two orders may be distinguished with certainty, others will probably have to be placed here.

Order 86. *Cordaitales*. Extinct, Paleozoic trees with elongated, narrow leaves and complex female cones.

Order 87. *Ginkgoales*. Maidenhair Trees. In Mesozoic, and probably Paleozoic times, there were many species of this order, but they are represented now by a single species native to China and extensively cultivated there and in Japan and to some extent in this country, *Ginko biloba* (Fig. 42). The trees are freely branched and possess fan-shaped leaves, notched at the middle of the outer edge. The microsporophylls are in small, loose cones; the seeds are borne singly or in twos at the apex of a long stalk.

Order 88. *Gnetales*. This order, consisting of three families, each with a single genus, is of very doubtful affinity. It may be related to this class or to the preceding one or its relationship may be elsewhere. The plants are more or less woody, with opposite leaves. The stems in two genera are green. The leaves are large or reduced to scales. The microsporophylls are borne singly or a few together in the axils of scales which are arranged in cones; i.e., the male cones are compound. Apparently the same is true for the female cones. The ovules (the term applied to the undeveloped seed) are naked. The sperms are not ciliated. There are three genera. Ephedra (Fig. 44) is found in arid regions, e.g., Arizona and the Mediterranean Basin. The plants of this genus are leafless and jointed. Gnetum with netted-veined, opposite leaves, forms climbing woody vines or even trees, in tropical regions. Tumboa, from southwest Africa, has a radish-shaped root surmounted by a short thick stem, reaching a thickness of a yard or more and bearing two, opposite, foot-broad leaves, several yards long.



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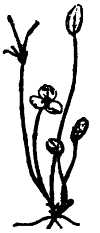

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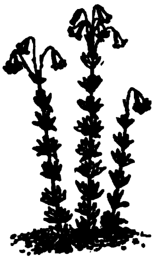

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Fig. 44.— Fragment of a Joint-fir (Ephedra), with clusters of microsporophylls; considerably reduced.

Fig. 45.— Plant of Water Plantain (Alisma), in flower; much reduced.

Fig. 46.— Plants of a Lily (Lilium), in blossom; greatly reduced.

Phylum XIII. Strobilophyta.— Conifers. The plants of this phylum are all woody, with secondary thickening of the stem. With the exception of a few low shrubs all are trees, some of them of great dimensions. The spores are of two kinds, megaspores and microspores. They are borne in separate cones on the same or on different plants. The megaspore is retained within the megasporangium (ovule) while it develops into a megagametophyte of a large number of cells with several archegones. The microspore, even before it leaves its sporangium, has begun its development into a gametophyte, by the cutting off of one or two small vegetative cells, the remainder being the antherid. This is carried by the wind to the megasporangium, and then the antherid begins to elongate, boring its way through the megasporangium tissue until the enclosed gametophyte with its archegones is reached. This tube (pollen tube) enters an archegone and one of the two non-ciliated sperms fertilizes the egg. The embryo develops much as in the preceding phylum, resulting in the formation sooner or later of a mature seed. The megasporangium (ovule) and resulting seed are borne on the open surface of well-developed or much reduced sporophylls which may be united into large cones or into small cones with only one or two of the sporophylls functional. The 400 living species form but one class (Class 31. *Pinoideæ*) with two orders.

Order 89. *Abietales*. The trees (rarely shrubs) of this order are resinous. The foliage of the majority of species is evergreen, the leaves being scale-like and appressed to the twig or needle-like. The megasporangial cones consist, usually, of many scales which are usually woody, but in some genera the cone scales are fleshy at maturity. The seeds are dry and hard, externally. The six families contain many trees of the utmost economic value. The commoner are Pinus (pines, Fig. 43), Picea (spruces), Larix (larches), Abies (firs), Sequoia (redwood and big-tree), Cupressus (cypress), Juniperus (junipers), Thuya (arborvitae), Tsuga (hemlocks).

Order 90. *Taxales.* The plants of this order resemble closely those of the preceding one, but the megasporophylls are usually single. The seeds are hard-shelled within and fleshy externally. Three families may be distinguished. The Yew of Europe and Ground Hemlock of North America belong to the genus Taxus. Podocarpus is an important tree of the Southern hemisphere.

Phylum XIV. ANTHOPHYTA.—The Flowering Plants. This immense phylum includes plants varying from great trees on the one hand to minute herbs on the other. The vast majority are chlorophyll-bearing, but a few species lack chlorophyll and are saprophytes or even parasites. The leaves are most typically broad with more or less netted venation, but in many groups the venation is parallel, and narrow leaves are found in some plants of nearly every large subdivision of the phylum. The foliage may be evergreen or may fall before the new leaves appear. The plants may live only a few weeks or for hundreds of years. The microspores (pollen) are borne in modified sporophylls (stamens), consisting of a stalk («filament») bearing usually four microsporangia (collectively, with the intervening tissues, known as the anther). The megaspores are produced in megasporangia (ovules) borne on megasporophylls (carpels) which are folded together and united at the edges or with the edges of adjacent megasporophylls to form closed cavities in which the ovules lie. These structures are known as pistils and are considered as simple if they consist of one megasporophyll and compound if two or more megasporophylls are united to form the pistil. Only one megaspore develops to maturity and produces a gametophyte. The latter (called embryo-sac) by division of the nucleus of the megaspore possesses eight nuclei of which six are set off by the organization of cells (but not necessarily with cell walls). One of these naked cells is the egg. The microgametophyte consists simply of one antherid with its tubular extension (pollen tube) which grows down through the tissues of the pistil and through the megasporangium (ovule) tissues to the egg which is fertilized by one of the sperm nuclei. The other sperm nucleus unites with the two nuclei at the centre of the embryo-sac and this stimulus leads to the resumption of the growth of the gametophyte to form the nutritive tissue (endosperm) used for the nourishment of the developing embryo.

The sporophylls are grouped in typical cones (called flowers) or these are much reduced in structure. The apical portion of the cone is occupied by the pistils or pistil; below these are the stamens and next the petals, showy modified leaves, and the sepals, usually green modified leaves that enclose the whole flower in the bud. In the primitive groups that show the closest relationship to the Bennettitales, the presumptive ancestors of this phylum, the sepals, petals, numerous stamens and numerous pistils are all spirally arranged in a large cone (e.g., flower of Magnolia), but as the evolution progresses we find the size of the flower and the number of each kind of part reduced in connection with modification of the spiral arrangement to whorled arrangement and the union of adjacent parts. Thus the flower of the Pink Family may have five whorls of parts, five to a whorl, viz., five sepals, five petals, two whorls of five stamens each and five megasporophylls united into one compound pistil. Besides reduction in number we may find actual loss of certain parts; thus many flowers lack petals and some lack sepals also. In some plants the stamens and pistils are found in separate flowers, either on the same plant (monœcious) or on different plants (diœcious). The more than 132,000 species are divided into two unequal classes and 32 orders.

Class 32. *Dicotyledoneæ.* The Dicotyledons are trees or shrubs with true wood, increasing in thickness by means of a cylindrical layer of cambium, or herbs whose vascular bundles, with few exceptions, also undergo secondary thickening. These bundles are mostly arranged equidistantly from the centre of the stem in one series. The leaves are mostly broad and net-veined. They are scattered along the stem or whorled or very often opposite. The parts of the flowers are most frequently in fives or fours, rarely in threes. The young seedling possesses two seed leaves (cotyledons). The first order of this class shows the greatest affinity to the Order Alismatales of the next class probably having given rise to it in the course of evolution. Likewise in it are shown most clearly the points of resemblance to the Bennettitales (*Phylum Cycadophyta*) from whose close allies the Anthophyta are believed to have evolved. The first 14 orders, from Ranales to Lamiales, inclusively, represent a line of development in which one structural idea remains predominant, with very few exceptions, viz., the pistil, stamens, petals and sepals are attached successively lower down on the elongated or short, but never saucer or cup-shaped flower axis. Sometimes the axis is flattened, in which case the points of attachment are successively further from the centre of the flattened area. The pistil or pistils, therefore, are superior. Beginning this line come orders in which the various parts are numerous and separate. Reduction in number is the first noticeable feature. Soon, however, the union of pistils to form a compound pistil appears. The number of parts in the whorls of sepals, petals, stamens and carpels becomes prevailingly established at five with two whorls of stamens at first, one soon disappearing. The number of carpels then begins to be reduced, reaching two for the higher orders. Finally we find certain stamens disappearing from the whorl. All along the line petals may disappear and sometimes even the sepals. The sexes may become separated in different flowers. With these changes going on, sometimes within one order it is difficult to make a characterization that will cover all the plants in the order without going to too great length. Indeed, were it not for so many intermediate forms we would hardly be able to justify the placing of such extremely different forms in one order as will be found here given.

Order 91. *Ranales.* Trees, shrubs or woody vines or herbaceous plants, mostly with alternate leaves (but opposite leaves prevail in some families). The flowers have their parts mostly spirally arranged upon the axis and free from each other. Mostly the flowers are radially symmetrical (regular), but in some cases they are zygomorphic and possess only bilateral symmetry. The pistils are attached to the axis above all other parts of the flower, i.e., they are superior. The carpels vary from many (typically) to few or even one; they are free; in a few cases only, being united into a compound pistil. The stamens are mostly numerous or indefinite in number, reduced to few in some cases. The seeds mostly contain a small embryo in copious endosperm. The approximately 5,600 species represent 24 families distributed all over the world. In temperate North America the Buttercup (*Ranunculus*, Fig. 47), Magnolia, Barberry (*Berberis*), Sassafras, Lotus (*Nelumbo*), etc., represent the commoner families of the order.

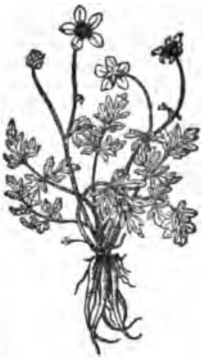

FIG. 47.—A Buttercup (Ranunculus) in blossom; greatly reduced.

Order 92. *Malvales.* Trees, shrubs and herbs with mostly alternate leaves. The radially symmetrical flowers typically are of medium size to large, with five sepals and five petals and numerous stamens united by their filaments into one or several groups. The pistil is superior and compound, with many loosely united carpels. By various steps we find also in this order plants in which the petals are wanting, or the number of stamens has been reduced to five or even to one (*Ficus*, the Fig), or the number of carpels is likewise small. The seeds may contain endosperm or not. The over 3,800 species represent about a dozen families, of which the following are important examples: Cacao (Theobroma), Cotton (Gossypium), Linden (Tilia), Elm (Ulmus), Hemp (Cannabis), Nettle (Urtica). Some of the families are strictly tropical in their distribution, others are world-wide.

Order 93. *Sarraceniales.* A small order of less than 100 species and consisting of two families. The plants are all herbaceous and possess leaves modified for catching and digesting insects. The radially symmetrical flowers have separate sepals and petals and a few to many stamens. The pistil is superior and compound and consists of three to five carpels with many seeds with endosperm. Perhaps this order ought to be united with the preceding one.

Order 94. *Geraniales.* This order, like the Malvales, is to be looked upon as derived from the Ranales. The plants are trees and shrubs, or herbs, with mostly alternate leaves. The flowers are mostly radially symmetrical. The petals and sepals are mostly in fives and separate; the stamens are mostly in one or two whorls of five. The superior compound pistil consists of five, sometimes fewer, mostly weakly united carpels, with many or but few, usually pendent ovules. As in other orders, we find a tendency toward reduction in parts in certain lines of development. Thus some of the over 9,200 species making up the 22 families of this order have lost their petals and in some cases the sepals have disappeared also. Similarly a reduction in the number of stamens shows itself at frequent intervals. As representatives of the commoner families may be mentioned the cultivated Geranium (Pelargonium), Wood Sorrel (Oxalis), Touch-me-not (Impatiens), Flax (Linum), Orange (Citrus), Castor Bean (Ricinus), etc.

Order 95. *Hypericales.* Nearly all the 3,100 species of this order are trees or shrubs, comparatively few being herbs, these being mostly extra-tropical, while the vast majority of the families are tropical. In a few families zygomorphy of the flowers is strongly developed; the majority, however, are radially symmetrical. The kinship to the Ranales from which the order probably arose is shown by the usually large number of stamens (rarely reduced to five) and by the separate sepals and petals and superior pistils. The latter are compound, consisting of several, rarely as few as two, carpels, often joined by their edges, so that the ovules are parietal, sometimes with axial attachments of ovules. The seeds mostly have no endosperm. The 20 families of this order are represented in temperate North America bv Saint John's Wort (Hypericum), Violet (Viola), Rockrose (Helianthemum), while in warmer regions of the world we find in cultivation Tea (Thea), Papaya (Carica) and Passion Flower (Passiflora).

Order 96. *Papaverales.* Trees or shrubs in some cases, but mostly herbs, usually with colored juices or pungent properties. Flowers radially or occasionally bilaterally symmetrical. Sepals and petals separate, usually in whorls of five or four, rarely numerous and spirally arranged; stamens many and spirally arranged or in one or two whorls and few in number; pistil superior, compound, of two to six, rarely more, united carpels; ovules mostly parietal; seeds with or without endosperm. Arising from the Ranales this group shows progression from forms with several carpels, many stamens (spirally arranged) and numerous petals and sepals toward those plants with two carpels, two or one whorl (sometimes incomplete) of stamens and five or four petals and sepals (or even two sepals). The seven families include nearly 3,000 species. The Poppy Family (*Papaveraceæ*) includes many plants frequently grown for the beauty of their flowers as well as several of medicinal value, e.g., the Opium Poppy (Papaver). The Mustard Family (*Brassicaceæ*) contains very many troublesome weeds and some important food plants such as

Cabbage, Turnip, Cauliflower, Mustard, etc. (Brassica), Radish (Raphanus), various kinds of Cress and other plants of less importance.

Order 97. *Chenopodiales.* Trees or shrubs, or far more numerously herbs, mostly free from harmful properties. Flowers radially symmetrical; sepals and petals usually present and in whorls of five, or in some families the petals lacking. The stamens are in two whorls or the inner whorl may be lacking; occasionally they are more numerous or fewer. The pistil is superior (with rare exceptions), and composed of several or few, most often five or three, united carpels. The ovules are borne axially or basally in the mostly one-loculed ovary. The seeds usually have a curved embryo embedded in endosperm. Nearly 4,500 species are included in this large order which comprehends 18 families. Its distribution is worldwide. As in the preceding orders the more primitive forms show their close kinship to the Ranales by their pistils consisting of several carpels; their many stamens reduced to two whorls as the first step and next, to one whorl, and their separate petals and sepals. This order is marked by the great frequency with which the loss of the petals occurs, their function being taken by the sepals or neighboring bracts which become showy, or the flowers becoming small and inconspicuous. Many of our commonest weeds belong to the latter type, such as Lamb's Quarters (Chenopodium), Pigweed (Amaranthus), Knotweed (Polygonum). Among the plants with more showy flowers are the Pink (Dianthus), Portulaca, etc. The Willow (Salix) and Poplar (Populus) are the most important trees of the order. They possess no petals.

The next seven orders are probably to be derived directly or indirectly from the more primitive forms of the foregoing order, i.e., those forms with parts in whorls of five each and all parts separate except the united carpels; with two or more whorls of stamens and with a tendency toward a unilocular ovary with free central placenta.

Order 98. *Diospyrales* (*Ebenales*). Trees or shrubs, mostly of warm climates. Flowers regular and perfect or sometimes the stamens and pistils in separate flowers. Sepals more or less united, as are the petals. Stamens in two or sometimes one or three whorls, usually attached to the united petals (corolla). Pistil of several united carpels with one or a few ovules in each carpellary cavity, usually superior. Seeds usually large, mostly with endosperm. This order is probably derived from some of the woody forms of the preceding order with the union of sepals and of petals as a forward step. The ovary is still mostly of several carpels and the stamens in more than one whorl. The four families contain over 1,100 species. The family *Sapotaceæ* contains some valuable tropical fruits, e.g., sapodilla (Sapota). The genus Diospyros of the *Diospyraceæ* (*Ebenaceæ*) furnishes the persimmon as well as many kinds of ebony.

Order 99. *Ericales.* Trees, shrubs and herbs of tropical and temperate climates. Flowers regular, perfect, with parts in fives or fours. Sepals and petals usually more or less united. Stamens in two or more often one whorl, mostly free from the petals. The superior (rarely inferior) pistil is compound, of two to many, mostly five or 10 carpels, each with several minute seeds with endosperm. A few species are parasite or saprophytes. The family *Ericaceæ* is especially associated with (but not confined to) heaths or peat bogs where, for example, the Cranberry (Oxycoccus) abounds. The order contains over 1,700 species in six or seven families.

Order 100. *Primulales.* This order, consisting of trees, shrubs and mainly herbs, appears to have arisen, like the two foregoing orders, somewhere in the Order Chenopodiales. The characters are more nearly like those of the Pinks (*Dianthaceæ*) than some of the other families. The flowers are regular, with parts mostly in fives. The stamens are mostly in only one whorl (the inner one, alternating with the sepals) sometimes with rudiments of the outer whorl as "staminodia." The pistils are mostly superior, composed of two to several carpels, usually as many as the petals, with a single locule. Seeds with endosperm. Of the approximately 1,600 species in this order the Primrose family (*Primulaceæ*, Fig. 48) is the largest in temperate regions. The Plantains (Plantago) probably are related to this family but their position is uncertain.

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Fig. 48.— Flower and leaf of a Primrose (Primula); greatly reduced.

Fig. 49.— A Foxglove (Digitalis), in bloom; greatly reduced.

Fig. 50.— Flowers and leaf of Strawberry (Fragaria); greatly reduced.

Fig. 51.— Leaf and flower-heads of Compass Plant (Silphium), one of the Asterales; greatly reduced.

Order 101. *Gentianales.* Trees and shrubs, less frequently herbs, largely of the warmer parts of the world, frequently with milky latex. Flowers regular, with sepals and petals united, usually in whorls of five; stamens as many as the petals (rarely only two), being the outer whorl and alternating with the petals. Pistil superior, composed of two, rarely four (sometimes loosely) united carpels, with mostly many ovules in each locule. Endosperm mostly present in the seed. Leaves mostly opposite. The 4,700 species represent six families, of which the following representatives may be mentioned: Lilac (Syringa), Olive (Olea) and Ash (Fraxinus), in the Olive Family (*Oleaceæ*); Gentian in the family of that name (Gentiana in the *Gentianaceæ*); Oleander (Nerium), Periwinkle (Vinca), and several important rubber plants in the Dogbane family (*Apocynaceæ*); Milkweed in the family of that name (Asclepias in the *Asclepiadaceæ*).

Order 102. *Polemoniales.* Trees and shrubs or (in temperate regions especially) more often herbs with mostly alternate leaves. Flowers regular, or somewhat bilateral in the higher families of the order; sepals and petals mostly in fives and united; stamens one whorl (the outer) alternating with the petals and equaling them in number. Pistil superior, consisting of five or three, in the higher families of two united carpels with two to many ovules to a carpel. Seeds mostly with endosperm. The Phlox family (*Polemoniaceæ*) shows great resemblance to the Primrose family in Order 100, but differs in having the single whorl of stamens the outer instead of the inner one, in having the number of carpels reduced and in having one locule for each carpel instead of one locule for the whole pistil. This order contains about 4,100 species and seven families. The Potato (Solanum), Forget-me-not (Myosotis), Dodder (Cuscuta), Morning Glory (Ipomœa) and Phlox represent respectively five of these.

Order 103. *Scrophulariales.* Trees, shrubs and (mostly in temperate regions) herbs, more often with opposite leaves. Flowers irregular, often strongly two-lipped, the sepals and petals usually in fives and united; the stamens representing the outer whorl, but with one or three missing or represented by stamonodia. Pistil superior and composed of two (rarely four) united carpels, with many ovules in the two or sometimes single locule. Seeds largely with endosperm. About 7,100 species and 10 families. The Foxglove (Digitalis, Fig. 49), Catalpa, Sesame (Sesamum), Broomrape (Orobanche), and Acanthus belong to this order.

Order 104. *Lamiales.* Trees, shrubs and herbs with mostly opposite leaves. Flowers usually strongly zygomorphic, sepals and petals united, in fives; stamens representing the outer whorl and, therefore, alternate with the petals, usually one or three missing. Pistil superior, of two united carpels, but often four or more loculed, with one ovule in each locule. The seeds contain little or no endosperm. Over 4,100 species, in four families. In the Verbena family (*Verbenaceæ*) are found such herbs as the Verbena and such trees as the Teak (Tectona). The Mint family (*Lamiaceæ*) contains many plants cultivated for seasoning, e.g., Sage (Salvia), Thyme (Thymus), Mint (Mentha), etc.

Contrasted to the structural idea, hypogyny, running throughout the foregoing 14 orders, that of the remaining 10 orders of the class Dicotyledoneæ is perigyny and epigyny. The axis of the flower is expanded below the region of attachment of the pistils or pistil into a disc or cup on the upper surface or edge of which the stamens, petals and sepals are attached, so that they arise at a level with the body of the pistil or above it. This is called perigyny if this cup-like axis does not grow fast to the pistil that it surrounds and epigyny if the enclosed pistil is grown fast to the investing axis-cup. In the most primitive families of this series the pistils are numerous and simple and the axis-cup shallow. Progression is along several lines; thus the number of pistils may be reduced to one simple pistil, or after the reduction has reached a certain point the remaining pistils may unite into a compound pistil. This may be free from the axis-cup or as evolution progresses this may grow fast to it so that we now find an inferior, compound pistil. Similarly the large, indefinite number of stamens of the more primitive families finally becomes reduced to one whorl of as many stamens as there are petals, or some stamens may even be missing in this whorl. The primitive families of the first order of this series are certainly closely related to the more primitive families of the order Ranales, which in its turn shows kinship to the ancestral forms among the Bennettitales.

Order 105. *Rosales.* Trees, shrubs and herbs with mostly alternate leaves. The flowers are mostly regular, but in one side line of evolution zygomorphy has become prevalent. Normally the sepals and petals are in fives or (less frequently) in fours, and separate, but in some families the petals have become lost and the sepals much reduced or also lost. In the earlier families the stamens are very numerous, but in several directions of evolution the number has been reduced to double or equal to that of the petals or sepals. In the less advanced forms the simple pistils are numerous; in one direction of evolution the number is reduced to one, in another direction the reduced number of pistils unites to a compound pistil. Perigyny is present in the lower members of the order, epigyny in some of the higher members. In one group of families the seeds lack endosperm, in other it is abundant. It is only by the presence of so many forms that are intermediate in their characters that these very diverse plants are united into one order. The species number over 14,000 and represent 20 to 25 families. The Strawberry (Fragaria, Fig. 50) represents one of the most primitive groups of the order, being in its flower structure very close to plants of the order Ranales. Other plants are the Rose (Rosa), Apple (Malus), Plum (Prunus), Acacia, Bean (Phaseolus), Clover (Trifolium), Currant (Ribes), Witch Hazel (Hamamelis), etc.

Order 106. *Myrtales.* Trees, shrubs and herbs with opposite or less often alternate leaves. Flowers regular with sepals and petals separate, stamens mostly many or reduced two to four times as many as the petals, rarely just as many or fewer. Pistil compound, of two to many united carpels, with as many locules, or with one locule. Ovules mostly numerous, sometimes reduced to one; seeds with or without endosperm. Pistils surrounded but free from the deep axis-cup in one family, in the remainder enclosed by and grown fast to the axis-cup (ovary inferior). In this order we find a progression from perigyny to epigyny, from many stamens to few stamens, and from possession of petals to apetaly in a few families. Furthermore, several of the 15 families are strict parasites and leafless. Among the latter should be mentioned the East Indian Rafflesia which grows inside the tissues of the woody host as long threads of cells, for all the world like a fungus, forming its flower buds beneath the bark of the host and finally bursting out to form an immense flower, in one species over a yard in diameter. The order contains nearly 7,500 species. The Myrtle family contains many trees of economic importance such as the Blue Gum (Eucalyptus), Allspice (Pimenta), Clove (Eugenia). In another family we find the Pomegranate (Punica). In this order, too, belong the Evening Primrose (Oenothera), Mangrove (Rhizophora), Brazil-nut (Bertholletia), etc.

Order 107. *Loasales.* Mostly herbs, rarely shrubs or trees, with alternate (only rarely opposite) leaves; frequently climbing vines. Flowers regular or in one family zygomorphic, with separate sepals and petals, usually in fives or fours. Stamens numerous or equal to or twice as many as the petals, sometimes fewer. Pistil inferior, composed of three or sometimes more, united pistils; with one or sometimes several locules. Seeds usually many, mostly without endosperm. The plants of this order tend to be more fleshy on the whole than in the preceding one, and the ovules are more prevailingly parietal. Both orders apparently have about the same origin and develop parallelly. About 1,400 species in five families. The Gourd family, with Muskmelon and Cucumber (Cucumis), Watermelons (Citrullus), Squash and Pumpkin (Cucurbita), etc., and the Begonia family are perhaps the most familiar representatives of this order.

Order 108. *Cactales.* This order appears to have arisen from the preceding one. The plants are herbaceous and very fleshy, in a few cases with leaves, but mostly leafless. The fleshy, green stem is modified in very remarkable ways and is usually spiny. The flowers are regular or nearly so, with numerous sepals, petals and stamens. The pistil is inferior, of four to eight united carpels, with the numerous ovules parietal. Endosperm is scanty or lacking. The single family contains nearly 1,200 species. These are mostly found in warm parts of the New World, frequently in exceedingly dry situations. The Giant Cactus of Arizona (Carnegiea) attains a height of over 60 feet, while the little Purple Cactus (Coryphantha) from Colorado to Alberta is only one to five inches in height.

Order 109. *Celastrales.* Trees and shrubs, rarely herbs, with opposite or alternate leaves. Flowers small, regular, with separate sepals and petals (the latter wanting in some families), which are usually in fives (or fours). Stamens as many as the sepals, rarely twice as many. Axis of the flower expanded into a more or less glandular, turgid disc, or ring, which partially surrounds the pistil and is grown fast to it in the further developed families. Pistil compound, of two to six (rarely more) united carpels with as many locules, or the locule, only one in certain families. Ovules few: seeds with or without endosperm. This order apparently arose from some of the Rosales in which the axis-cup was shallow and in which epigyny had not yet been developed. However, the reduction in number of stamens had been established and the pistils were compound. Some of the 24 families are included here very doubtfully. In three families the plants are true parasites and in another many species are at least partially so. Belonging to this order are the Grape (Vitis), Holly (Ilex), Sandalwood (Santalum), Mistletoe (Viscum and Phoradendron) and many other plants of economic interest.

Order 110. *Sapindales.* Trees and shrubs (very rarely herbs), with alternate or opposite leaves. Flowers small (with few exceptions), regular (occasionally zygomorphic), sepals and petals separate, from 3 to 10 in number, usually four or five, petals often wanting. Stamens as many as the sepals, rarely twice as many. Axis developing a more or less pronounced disc which is grown fast to the compound pistil in the higher families but free from it in the lower ones. Carpels one or two to five, mostly two or three; pistil with one or several locules; ovules one or two in each locule; seeds without endosperm. This order probably arose from somewhere in the preceding order from which it differs in the mostly smaller number of ovules and carpels, and in the very strongly marked tendency to apetaly. The 15 families contain nearly 3,000 species of plants, of which the following may be mentioned: Maple (Acer), Sumac (Rhus), Mango (Mangifera), Walnut (Juglans), Birch (Betula), Oak (Quercus).

Order 111. *Ammiales.* Trees or shrubs or herbs with alternate or opposite leaves which are very frequently compound. Flowers regular, small, pentamerous or tetramerous; calyx of small sepals, sometimes reduced to a mere border. Petals (rarely wanting) small, separate. Stamens as many as the petals and alternating with them. Compound pistil inferior, of two (rarely three or more) united carpels with a single ovule in each locule. Seeds with endosperm. The flowers are usually borne in large numbers in umbels or small heads, often with the marginal flowers larger and showy. This order of three closely related families and over 2,800 species probably arose from some of the higher Celastrales. In the *Araliaceæ* we find the English Ivy (Hedera) and Ginseng (Panax); in the *Cornaceæ* we find the Dogwood (Cornus); and in the *Ammiaceæ* Celery (Apium), Carrot (Daucus), Fennel (Fœniculum), Parsnip (Pastinaca), etc.

Order 112. *Rubiales.* Trees, shrubs and herbs with opposite leaves which are entire or more or less dissected. Flowers medium-sized to small, regular or sometimes more or less zygomophic, single or more often in clusters of various types, including umbels and heads. Sepals and petals in fives or fours; sepals often small. Petals united into a tube or merely at their bases. Stamens separate, as many as the petals and alternating with them. Pistil inferior, of two to three, sometimes more united carpels, and one to many ovules in each locule, or in one family the locule single with one pendent ovule. Seeds mostly with endosperm. This order of about 5,100 species and five families shows kinship to the preceding order from which it differs chiefly in the united petals. Coffee (Coffea), Elder (Sambucus), Honeysuckle (Lonicera), Teasel (Dipsacus), etc., are members of this order.

Order 113. *Campanulales.* Trees and shrubs, more often herbs, with mostly alternate, undivided leaves. Flowers mostly showy and moderately large, regular or markedly zygomorphic, with sepals and petals mostly in fives. Sepals separate or partly united; petals united into a wheel-shaped or more often more or less bell-shaped corolla which is sometimes two-lipped. Stamens as many as the petals and alternating with them or fewer; united by the anthers or by the filaments or if not united at least in many cases with the anthers closely crowded around the style. Pistils compound, of two to five united carpels, mostly with as many locules as carpels and many ovules in each, in one family with one locule and a single pendent ovule. Pistil inferior, sometimes completely, sometimes only partially. Seeds mostly with endosperm. This order differs from the foregoing one in the prevalence of alternate leaves, in the tendency for the stamens to be more or less united, and in the greater inclination toward herbaceousness. The two orders are closely related and probably have a common origin. Five or six families are recognized, containing in all toward 1,600 species. The Bellflowers (Campanula) and Lobelia are among the best-known members of this order.

Order 114. *Asterales*. Trees and shrubs or most often herbs with alternate or opposite leaves and great variety of stem structure. Flowers united into heads with the marginal flowers sometimes modified into showy structures («rays»). Flowers regular or zygomorphic. Sepals very various, e.g., united to a low ridge, separate, chaffy scales, numerous small teeth, or long simple or feathery threads (as in thistle down). Petals five (very rarely four), united into a tube and regularly or irregularly lobed above or the tube split down on one side. Stamens five, attached at the base of the corolla tube, with separate filaments, but with united anthers. Pistil inferior, with one locule and one ascending ovule, bicarpellary. Seed without endosperm. An immense order of over 14,000 species, formerly regarded as a single family, later as constituting three families, but here regarded as representing 14 (the tribes of other authors). This order is regarded as the culmination of the evolutionary development of the Phylum Anthophyta. Among its members may be mentioned the Sunflower (Helianthus), Compass Plant (Silphium, Fig. 51), Goldenrod (Solidago), Thistle (Cirsium), Lettuce (Lactuca), etc.

Class 33. *Monocotyledoneæ*. The monocotyledons are mostly herbaceous plants, rarely trees, without true wood and without the power to increase in thickness (secondary thickening). The vascular bundles are scattered in the stem, not equidistant from the centre. The leaves are mostly scattered along the stem, rarely whorled and only exceptionally opposite. They are long and narrow and parallel-veined, or if broad usually have a midrib, with the lateral veins parallel. The parts of the flowers (sepals, petals, stamens and carpels) are mostly in three's. The seed leaf (cotyledon) is single (apparently through the failure of one of the two that start to form to continue its development). The evidence drawn from structure and from the development of the embryo makes it seem probable that this class arose from some of the herbaceous members of the preceding class (*Dicotyledoneæ*), almost certainly from Order Ranales, close to the Family Ranunculaceæ. Indeed, that group and its near relatives sometimes show a suppression of one cotyledon, a scattered arrangement of vascular bundles which even may lack the power of secondary thickening, and a trimerous arrangement of the parts of the flower. Furthermore, the members of what seems to be the most primitive order of the Monocotyledoneæ, the Alismatales, frequently possess net-veined leaves, and in seedlings of many members of this class traces are found of secondary thickening in the vascular bundles. The eight orders comprise nearly 24,000 species.

Order 115. *Alismatales*. Herbaceous, in one family shrubby or tree-like. Usually in wet soil or aquatic. Pistils simple, mostly more than one, superior to all other parts of the flower, which are also not united to each other. In some of the nine families both petals and sepals are present, in others these are lacking or represented by scales or bristles. Of the 400 species that make up the nine families some are marine; almost the only flowering plants that grow in the ocean. The Water Plantain (Alisma, Fig. 45) is world-wide in its distribution as are some of the Pondweeds (Potamogeton).

Order 116. *Liliales*. The Lilies. The plants of this order are only exceptionally aquatic or marsh inhabitants. They are herbaceous with a few exceptions. The pistil is compound, consisting of (usually) three united carpels. The stamens are in two (sometimes, by suppression of one whorl, one) whorls of three each and the petals and sepals are well developed and often alike. The flowers are radially symmetrical or nearly so. The pistils are attached to the flower axis above all the other parts (pistil superior). The flowers are mostly showy and borne singly or in spikes or various other types of inflorescence, rarely closely crowded. Here are to be found many of the most beautiful flowering plants such as the Lilies proper (Lilium, Fig. 46), Lily of the Valley (Convallaria), Crown Imperial (Fritillaria), Tulips (Tulipa), Mariposa Lilies (Calochortus), Spring Lilies (Erythronium), Hyacinths (Hyacinthus), Day Lilies (Hemerocallis), etc. There are 12 or 13 families and nearly 3,400 species.

Order 117. *Arales*. The Aroids. These have a flower structure derived from that of the Liliales. The pistil is superior and typically tricarpellary, each carpel usually with two or more ovules. The petals and sepals are reduced to small scales or are entirely wanting. The flowers are perfect (stamens and pistils in the same flower) or the stamens and pistils are in separate flowers, usually then not far distant. The flowers are crowded on rather thick, fleshy spikes which are frequently surrounded and overtopped by a large bract (spathe). In a few cases this spike is reduced to a short axis with only one or two flowers. The plants are mostly large: in some cases being palm-like and somewhat woody, but in most cases herbaceous and upright or climbing. The leaves are large and often net-veined, and entire or lobed or compound. In one family (*Lemnaceæ*, the Duckweeds) the leaves are lacking and the small floating stem is flattened and thallus-like, bearing only one or two flowers at the edge. The 1,100 plants of

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FIG. 52.— A Calla Lily (Richardia), in blossom; greatly reduced.

FIG. 53.— A Date Palm (Phœnix); greatly reduced.

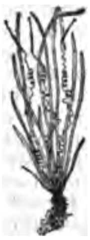
FIG. 54.— A Brome Grass (Bromus), in blossom; greatly reduced.

this order make up three families which are mostly inhabitants of the warmer regions of the world. In North America the family *Araceæ* is represented by the Jack-in-the-Pulpit (Arisæma), Sweet Flag (Acorus), Skunk Cabbage (Spathyema), etc., while in cultivation we find the Calla Lily (Richardia, Fig. 52) and the Elephant's Ear and Taro (Colocasia), etc. The third family (*Cyclanthaceæ*) consists entirely of tropical forms of which only a few are grown in greenhouses in the temperate regions.

Order 118. *Arecales.* The Palms (Fig. 53) are nearly all shrubs or trees, often 50 to 100 feet in height, but without true secondary thickening. Their stems bear a crown of pinnate or palmate leaves at their summits, and among them are the axial (rarely terminal), usually much-branched inflorescences along whose branches the flowers are attached. The inflorescence has one or more large bracts that enclose it when young. The flowers are of the Lily plan, consisting of a superior, tricarpellary, compound pistil producing from one to three seeds, and two whorls of three stamens each and three rather small petals and sepals respectively. The petals and sepals are lacking in some palms and in many of the tribes the stamens and pistils are in separate flowers. The single family (*Arecaceæ* divided by some authors, perhaps with right, into five or more families) includes more than 1,100 species, all natives of warm climates. Among these are the Coconut Palm (*Cocos nucifera*), “The most useful plant in the world,” the Date Palm (*Phœnix dactylifera*, Fig. 53), the Palmetto (Inodes palmetto), etc.

Order 119. *Poales.* The plants of this order are grass-like plants (with the exception of the bamboos, herbaceous), with slender stems and simple, usually narrow leaves. The superior, compound pistil is tricarpellary or bicarpellary (rarely more than tricarpellary), with one ovule to each carpel, or where the pistil has but one locule only one ovule in the pistil. The perianth is reduced to small scales or bristles. The inconspicuous small flowers are accompanied with chaffy bracts. The seeds possess abundant endosperm. Of the five families in this order the Sedges (*Cyperaceæ*, about 3,000 species) and Grasses (*Poaceæ*, about 3,500 species) are the most important. These two families form the chief food for the vast numbers of cattle and wild herbivorous animals that live on prairies and in open forests. The former may be distinguished by the fact that the leaves are three-ranked with their sheaths closed to form a tube while in the grasses they are two-ranked with the sheaths split down one side. In the sedges the embryo is embedded in the endosperm; it lies at one side of it in the grasses. The chief sedges of the temperate regions of North America are very numerous species of Carex, of Cyperus, of Scirpus (Bulrush), etc., while the vast number of grasses include Timothy (Phleum), Red Top (Agrostis), Orchard Grass (Dactylis), Brome Grass (Bromus, Fig. 54), and such cereals as Wheat (Triticum), Rye (Secale), Oats (Avena), Barley (Hordeum), Maize (Zea), Rice (Oryza), etc. The Bamboos (Bambusa and Phyllostachys) are large perennial woody grasses of the warmer regions of the world where they often attain tree-like dimensions.

Order 120. *Hydrocharitales.* The plants here included are all aquatic and mostly submerged. They are found in fresh and salt water. Their compound pistils are formed of three or more united carpels and are interior (i.e., the portion of the flower axis on which the petals and sepals are borne has grown up around the pistil, growing fast to it so that the petals and sepals seem to rise from the upper part of the pistil). They have but one cavity with the mostly numerous ovules parietal. The flowers are of separate sexes, or in some cases perfect. The stamens are in one to several whorls of three. The seeds contain no endosperm. The relationship of the order is uncertain, but it seems possible that they are to be considered as derived from the Alismatales or from the Liliales not far from the point where they arose from the Alismatales. The 50 or more species of the order are placed by some authors in one, by others in two families. Eel-grass (Vallisneria, Fig. 55) and Waterweed (Philotria) are common plants of this order. The latter has become a pest in streams in Europe into which it was introduced from its native home, America, filling them up and even impeding navigation.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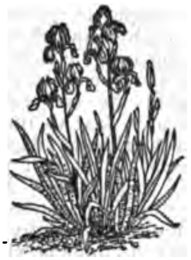
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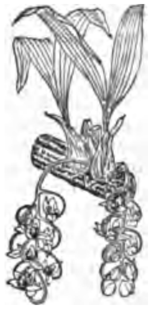
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Fig. 55.— Plant of Eel-grass (Vallisneria), in blossom; greatly reduced.

Fig. 56.— Iris plants in blossom; greatly reduced.

Fig. 57.— An epiphytic Orchid (Gongora), with pendent flower clusters; greatly reduced.

Order 121. *Iridales.* Herbaceous plants, sometimes of large size, often vines. Flowers radially symmetical or nearly so, with complete trimerous whorls of sepals, petals, stamens and carpels. Stamens in two whorls or the inner or outer whorl lacking. Pistils inferior. These plants are very closely related to the Liliales from which they were undoubtedly derived. The chief difference is the inferior pistil as compared with the superior pistil of that order. About six families include the 1,850 species of this order. Among these may be mentioned the Irises (Iris, Fig. 56), the true Yams (Dioscorea), Amaryllis, Gladiolus, Narcissus, etc.

Order 122. *Zingiberales.* The plants of this order are, like those of the foregoing one, herbaceous, in the case of the bananas being of tree-like dimensions. The flowers are somewhat to exceedingly irregular, either by their dorsiventral symmetry or by total lack of symmetry. The whorls of stamens are usually incomplete, certain members being lacking or replaced by petaloid “staminodia.” The pistil is inferior and consists of three united carpels with one to many seeds in each. This order is closely related to the foregoing one from which it differs chiefly by its zygomorphous or asymmetrical flowers with incomplete whorls of stamens. The Banana (Musa), Ginger (Zingiber), Canna, etc., are well-known representatives of the group which contains about 550 species in four families.

Order 123. *Orchidales.* The two families generally placed in this order are not with any certainty to be placed together. Possibly the one (*Burmanniaceæ*) should be placed with the Iridales. The two agree, however, in the inferior, tricarpellary pistil with very numerous, minute seeds with no or very little endosperm. In the one family (of about 60 species) the flowers of some species are radially symmetrical, of other species zygomorphic, the latter being the case throughout the other family (*Orchidaceæ*). In the latter family, three, four or five stamens are suppressed, while in the former both whorls or only one whorl may be present. The plants are all herbaceous. The Orchids (Fig. 57) number upwards of 7,500 species and are found from the cooler temperate zones to the tropics where they reach their greatest development. They are terrestrial or epiphytic, green or in a few cases lacking chlorophyll and then gaining their food from decaying organic matter in the soil. None are parasites. The flowers are strongly zygomorphous, with the one or two (rarely three) stamens grown fast to the pistil. They show the most remarkable adaptation to fertilization by insects. Although grown largely for the beauty of their usually long-persisting flowers, e.g.— Cattleya, Catasetum, Dendrobium, etc., the only orchid widely cultivated for other purposes is Vanilla, a climbing vine with thick, green stem and flat leaves, whose long slender pods are the «Vanilla beans» of trade. Among the commoner native orchids of temperate North America may be mentioned the Lady's Slipper (Cypripedium), Orchis, Pagonia, etc.

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PLANTS, Diseases of. Diseases in plants have existed as long as plants themselves — ages before the advent of man. Civilization and agriculture have usually developed together in all parts of the earth and it is not strange that anything that troubled or destroyed an important food plant should be observed and the cause sought. In the earliest historic records as well as in early Greek and Roman times some of the more destructive diseases of plants, like rust and mildew or blight of cereals, were widely known and discussed. A special deity was recognized who ruled these phenomena and to whom sacrifices were offered.

Injury due to animals, especially insects, and to extremes of weather and unfavorable soil conditions were early often associated with their appropriate causes. It was not, however, until the latter part of the 18th and the beginning of the 19th century that the solid foundations of plant pathology were laid by the development of anatomy and physiology. The early works of Unger, ‘Die Exantheme der Pflanzen,’ etc. (1833); Weigmann, ‘Die Krankheiten und Krankhaften Misbildungen der Gewälchse’ (1839), and of Meyen, ‘Pflanzenpathologie’ (1841), mark an important step forward in the embryo science of plant pathology. During this period miscroscopical chemical and physiological work with plants was active. The writers of this period rather overworked unfavorable nutrition as the cause of disease. Maladies that could not be traced to visible external causes were usually held to be due to unsuitable nourishment or the lack of something in the soil. It was not believed that the fungi so often found associated with diseases had any casual relation to them. They were held to be abnormal developments of the diseased cells themselves and not independent organisms. It remained for De Bary to determine the true nature and habits of fungi and bacteria and to demonstrate their causal relation to disease in many cases. His careful work gave a great stimulus to investigation in plant and animal pathology and opened what has proved to be the most important field of the science. His two most important works are ‘Untersuchungen über die Brandpilze,’ etc. (1853), and ‘Morphologie und Physiologie der Pilze,’ etc. (1866). Since De Bary the rapid development of the subject is well represented by the works of Hartig (1874–89), Frank (1880–96), Soraurer (1886–88), Marshall Ward (1889–1901). The last work, ‘Diseases in Plants,’ is one of the most excellent and readable expositions of the subject that has appeared.

Health and Disease Compared.— That there is no defined line between health and disease is generally recognized by pathologists and physiologists. A plant continually varies in response to changes in its environment. There is, however, for each individual and for a given species as a whole a certain accustomed range or power of adaptation to each factor of its environment and to the various combinations of these factors. The process of natural selection operates to perfect this adaptive attuning of the individual and the species as a whole to the conditions under which they live. If these conditions are subject to great extremes of moisture and dryness or heat and cold, the natural or indigenous vegetation will be found, as a rule, equal to the emergency, while an introduced species, if developed under an environment not subject to such extremes, might be seriously injured or destroyed, and if the change is very unusual even the indigenous species may suffer. A moist, warm, cloudy spring may be followed by dry, hot weather and the tender watery growth be so much dried out and checked that it may be deformed and abnormal in shape, structure and size. This variation may be slight or it may be great. If it is slight it may have no appreciable effect on the vigor and growth of the plant. The leaves becomes a little firmer and smaller and more resistant to the hot, dry conditions, while the maturer leaves that cannot adapt themselves to the change turn yellow and fall, cut off by the parent plant. The plant is better for the change and can live under the modified conditions with greater ease and safety.

If the variation is greater the growth of the plant may be decidedly checked, the leaves being small and many more of them shed. In still more extreme cases the tender leaves may be dried up and killed either wholly or in part. According to Hartig, «It is only when the sickly condition leads to the death of some part of the plant that we may speak of actual disease.» Where a few leaves, unable to adapt themselves to a changed condition, turn yellow and fall, the leaves themselves may be diseased, but the plant as a whole is benefited by their loss by being relieved of sources of uncontrolled drain of its water supply. As the loss of leaves becomes greater, however, we pass from the extremely localized disease to a point where the whole or a considerable part of the plant is weakened, either by the direct loss of food that should be furnished by the leaves to the rest of the plant structure or by the use of reserve food in the reproduction of lost parts. It is evident in such cases that the border line between health and disease is hard to define. The case is not much easier if, instead of variations produced by moisture and temperature, we consider those caused by insects or fungi. A few leaves eaten from a tree by some insect or destroyed by a fungus might have no injurious effect on the tree as a whole and might even be an advantage, but as the number of injured leaves increases the tree is weakened and its life threatened. Slight doses of certain poisons stimulate the cells to more vigorous growth, acting as a tonic, while a little larger dose poisons and destroys the cell. Leaving all questions of consistency of definition, we may practically define as diseased all those conditions of a plant which directly or indirectly endanger its life or prevent normal development under given conditions of environment. Or, as Marshall Ward puts it, «We may define disease as dangerous disturbances in the regularity, or interference with the completeness or range of the molecular activities constituting normal life — that is, health — and it is evident that every degree of transition may be realized between the two extremes.»

Classification of Diseases.— The method of classification adopted is more a matter of convenience than importance. Most writers in plant pathology base their classifications on the causes of disease. Frank, for example, adopts the following outline: (1) Effects of insufficient room or space; (2) Effects of wounds; (3) Diseases due to atmospheric influences; (4) Diseases due to soil influences; (5) Diseases due to the action of injurious substances; (6) Diseases due to injurious plants; (7) Diseases due to injurious animals; (8) Diseases without any noticeable causes.

Hartig discusses diseases of trees according to the following scheme: (1) Diseases induced by Phanerogams; (2) Diseases induced by Cryptogams; (3) Wounds; (4) Diseases due to unfavorable conditions of soil; (5) Diseases due to unfavorable atmospheric conditions. While a classification based on cause is more scientific and more convenient for the pathologist, classifications based on the plant, the part of the plant attacked and the symptoms are the most intelligible and convenient for those who devote themselves to the practical cultivation of plants. According to such an arrangement we should have diseases of roses, carnations, violets, lilies, wheat, corn, oats, rye, apple trees, peaches, plums, maple, alder, birch, etc. Under each head we could subdivide into diseases of roots, stems, leaves, flowers and fruits, and again according to symptoms — decay or loss of parts, swellings, galls, shrinking, cankers, spots, discolorations, etc., finally coming down to the causes. It cannot be too strongly urged that pathologists writing for practical men adopt this latter type of classification at least as a key for the identification of specific diseases, as Hartig has done in his excellent work on the 'Diseases of Trees.' In practice we have in plant pathology, the same as in animal pathology, first carefully to examine, determine and interpret the symptoms (diagnosis), then to find and study the causes (etiology). We are then in a position to determine curative measures (therapeutics) or preventive measures (prophylaxis).

The general survey of the subject of plant pathology as planned in this article is based on the following classification:

I. Constitutional conditions — predisposition and immunity.
II. Diseases without apparent cause.
III. Diseases caused by the non-living environment.
  (*a*) Conditions of soil or substratum.
  (*b*) Atmospheric conditions.
  (*c*) Temperature.
  (*d*) Light.
  (*e*) Electricity.
  (*f*) Shock or jars — mechanical.
IV. Diseases caused by the living environment.
  (*a*) Antagonistic association, crowding, isolation, etc.
  (*b*) Vegetable parasites.
  (*c*) Animal parasites.

Constitutional Conditions — Predisposition and Immunity.—A plant may be likened to a very delicately constructed and complex machine automatically adjustable under certain conditions and capable of running and doing work if properly supplied with energy. The accurate and perfect working of the machine depends first upon the perfection of its construction and adjustment, down to the minutest detail. It comes from the manufacturer with a wheel or screw missing, or the parts incorrectly adjusted or made, it must do its work, if at all, with more or less imperfection, and we may consider that the mechanism has a constitutional difficulty or imperfection. Perhaps a new machine is assembled from parts of old ones so differing from each other that it becomes impossible to produce a perfectly coordinated mechanism. Some of the variations that occur in the constitution and organization of plants during the process of reproduction and development are of the nature of such imperfect construction or adjustment. When these imperfections endanger the life of the plant we have a constitutional disease, or at least a predisposition to disease.

Predisposition to disease may be normal or abnormal. Normal predisposition is where some perfectly normal condition of growth makes the plant liable to injury. Young cereal plants, for example, are liable to infection by smuts, while older plants are quite resistant. When the formation of young, tender growth coincides with the spore dissemination of some fungus or the prevalence of some insect best able to attack growth in such condition, the plant is at this stage normally predisposed to such attack. In the same way there may be normal predisposition to injury by cold, light, heat, etc., but in no case of this kind could the predisposition be considered in any sense disease. Abnormal predisposition is where some abnormal change takes place in the plant from any cause which lowers its vitality or resistance, and which is in itself a pathological condition. Wounds and mechanical injuries may permit the entrance into the plant of insect or fungous parasites, as is the case with many of the wood rot fungi. Injuries from cold or heat may reduce the normal resistance to parasites. Plants which have been severely chilled during rapid growth, though not to the point of killing or even freezing, are often unable to resume normal growth even under the most favorable conditions. They appear to be partially paralyzed and are in this condition extremely subject to insect and fungous attack. So many predispositions develop as the result of starvation, overfeeding or unbalanced nutrition even before the initiative pathological changes have become chronic.

Genera, species and individuals vary among themselves in liability to disease or resistance to it as they do in other ways. Races resistant or immune to certain unfavorable conditions or parasitic enemies are common in nature, and may develop as the result of natural selection, or more quickly and certainly as the result of artificial selection of a natural tendency. If a natural tendency to resistance is not present in a given species, race or variety, it may be introduced into new generations through the processes of breeding and selection combined. The production of plants for special purposes resistant or immune to certain diseases is proving of immense value to agriculture. On the other hand, both in natural and artificial selection and breeding, non-resistant or sensitive individuals, varieties and races may develop or be developed unusually subject to disease.

Seedless or non-fertile individuals may result from too close fertilization, or where the parents are too distantly related; or if seeds are produced in such cases, the individuals grown from the seeds often lack in vigor or reach an incomplete or imperfect development the same as in animals.

Many species of plants, like the violet, strawberry, lilies and bulbous and tuberous rooted plants in general, are naturally propagated by vegetative offshoots, runners, buds, bulbs, etc., and by seeds. The seed generations under normal conditions are usually the most vigorous and variable. Take, for example, plants from the seeds of *Lilium harrisii* (Bermuda lily), derived from crossing individuals of the same variety, as compared with plants from bulblets of the same individuals propagated for many years by bulb generations, and note the differences. The plants direct from the seed and from the bulbs produced by the seedling generation are relatively much more vigorous than the plants from bulbs distantly removed from a seed generation. The latter are much more sensitive than the former to the attacks of aphides and red mites on the leaves and the bulb mites on the bulbs and roots. The latter are also more sensitive than the former to fungous parasites, and to unfavorable conditions of the non-living environment. The same is true of the cultivated violets, especially the varieties that are propagated from runners and seldom produce seed on account of the doubling of the flowers. Long continued asexual propagation appears in these cases to gradually reduce the power of individual adjustment or adaptation to changes in environment, resulting in decreased vigor and resistance to unfavorable conditions. On the other hand, there are many varieties of plants thus propagated that do not appear to suffer in this way. That it is the cause of predisposition to disease in some cases, and even constitutional derangement, must not be overlooked in the study of ætiology of a disease.

Diseases without Apparent Cause.— Under this head a number of obscure but well-defined diseases are grouped, the ætiology of which is still unknown. Among these are the California vine disease, peach yellows and peach rosette, little peach, some forms of gummosis of the stone fruits, die back of the orange and a score of other diseases, apparently contagious, though the cause has not yet been found.

Variegation.— Formerly variegations were included in this class. These are characterized by the development of white, yellow or colored spots, blotches, segments, stripes or bands in the otherwise apparently normal green leaves. The transition from the diseased to healthy cells is usually sharp and well defined from the youngest to the oldest stages of the leaves or other tissues involved. Any particular cell is subject to the disease only while in a state of active division. It, therefore, never spreads to a cell that has stopped dividing. The diseased cells are usually smaller than healthy cells, and are of much slower growth. The nucleus and protoplasm are more vacuolate, but the most apparent change is in the development of the chloroplast and the chlorophyll. The chloroplasts may be reduced in number and size, and the chlorophyll may be reduced or entirely absent. The change in the diseased cells themselves is often progressive, starting with a reduction of chlorophyll, gradually fading to yellow, then to white as the cell matures. In many cases the disease is transmitted through the seed and is thus hereditary. In others it is propagated only by division of the original plant by buds, cuttings, etc. When a variegated bud or branch is grafted into young, rapidly-growing tissues of a normal or healthy plant of the same variety, branches formed above and below the graft often become variegated, demonstrating that the disease is thus transmissible or infectious. When it once appears in a plant it is very persistent, especially when it has gone to the point of involving the seed generation. Sometimes, however, a plant which has been producing variegated growth suddenly returns to the normal green. While such changes are usually classed as spontaneous variations, they differ in many respects from normal variation. Recent investigations by the writer and others have demonstrated that variegations, including the so-called mosaic diseases, develop as the result of certain disturbances of nutrition of the young dividing bulb cells.

All forms of variegation weaken the tissues involved and make them more subject to insect and fungous attack and more easily injured by cold or high temperature. Besides this the changes are in themselves strictly pathological, and threaten or cause the premature death at least of the parts affected.

Albinism.— When the loss of the green coloring matter is complete and apparently spontaneous, not curable by addition of some lacking nutrient, it may be classed with variegations. Other forms of albinism, yellowing or chlorosis are brought about by lack of iron, excess of lime, carbonic acid, lack of light, etc., and will be further discussed when these factors are considered in relation to disease. The cure and prevention of diseases of this class must be based on securing and maintaining a correctly balanced nutrition for the young cells — protecting them from shocks, especially those due to temperature variations. Peach yellows and rosette, California vine disease, die back of the orange and diseases of this type can be controlled only by rooting out the diseased individuals upon the appearance of the first symptoms. At the present time we know no cure for these particular diseases. In many respects they behave like variegation or mosaic diseases.

DISEASES CAUSED BY THE NON-LIVING ENVIRONMENT.

From what has been said in previous paragraphs, it is evident that unfavorable physical and chemical conditions of the soil, excessive dryness or moisture of the soil or atmosphere, unfavorable conditions of temperature, light, etc., may cause derangements resulting in temporary or chronic disease. Plants which have become adapted by natural or artificial selection to a certain range and sequence of soil, moisture, temperature and light conditions usually suffer some sort of derangement if exposed to a set of conditions materially different in any particular factor, group of factors or in the relation of these to each other. It is absolutely necessary, therefore, in studying the ætiology of diseases to know the natural or constitutional requirements of the plants and their powers of adaptation. This knowledge can be obtained only by long and intimate acquaintance with the kind of plants in question under varying conditions.

Soil.— In natural conditions it is a matter of general observation that certain varieties of plants thrive best on particular kinds of soil, the same as in particular conditions of light, temperature and moisture. The storage and movement of water in soils and its availability to plants, the solution of soil foods, nitrification, temperature and aëration depends largely upon the structure or physical composition of the soils. Water, food, air and temperature are among the fundamental requirements of vegetation. It is the varying amounts and relations of these factors maintained by a given soil that largely determine whether or not it is *naturally* suited in a given region to a particular class of plants. Where all these conditions are under easy control the kind of soil is a matter of less importance. The work of furnishing and maintaining proper conditions is done by the gardener instead of by the soil in the latter case. It is not profitable, however, to employ soils that require close and constant attention, even where conditions are largely under control. It is the aim of economical production to select a soil for a given crop that, with a minimum of labor expended on the part of the cultivator, produces the desired results. It is evident from these considerations that the conditions of the soil must be considered in connection with all of the other factors of environment, as no one of them ever acts independently and alone in the production of disease. The plant, too, has to be considered. It may be adapted to withstand the variations that take place in a sandy soil in a locality characterized by particular meteorological conditions, while it could not thrive in a clay soil in the same locality. On the other hand, with changed meteorological conditions the same plant might do best in the clay soil.

Root Suffocation.— This is one of the most usual diseased conditions caused by physical conditions of the soil preventing the ready access of atmospheric oxygen or the ventilation of the soil. A very fine sand closely packed, or a clay soil with a crust excludes the air, unless the sand is stirred or the crust broken. Carbondioxide accumulates and the oxygen is reduced. The root hairs and feeding roots die for lack of sufficient oxygen for respiration. Growth is checked by starvation due to reduced root action. The tissues become hard and woody. The plant may then die in dry, hot weather by desiccation, or it may simply starve to death. Plants injured in this way, even slightly, often become the prey of insects and fungi, especially of those that attack the roots. This form of suffocation is also often found where the roots of plants have to grow under close pavements or hard packed ground or heavy sod. Another form of root suffocation results from poor drainage or excess of moisture in a soil, thus excluding the oxygen and preventing soil ventilation. The feeding roots die and ferment, not only cutting off the proper absorption of soil food elements but resulting in poisoning the plant by products of fermentation. The leaves rapidly turn yellow and drop, and unless the soil is dried out and aërated the plant soon dies. This latter form of root suffocation is very common among plants grown in pots or tubs. When the natural drainage is stopped up or the plant is over-watered, the soil becomes sour.

The best thing to do in such a case is to repot the plant into fresh soil containing a little lime or wood ashes, first washing off the old soil and trimming off the diseased roots. Good drainage must be furnished and over-watering avoided. It must be clearly understood that the roots of most plants require an abundant supply of oxygen, and that they will suffocate and die if they do not get it.

Poisonous materials in the soil are also often the cause of serious root injury. Illuminating gas leaking from gas mains or pipes and diffusing through the soil in the minutest quantity kills and poisons the roots of all kinds of vegetation. The only thing to do in such cases is to stop the leak and air the soil.

The decomposition of organic matter, especially manures rich in nitrogen, in soils not well supplied with oxygen, results in the formation of products injurious to the roots of plants. Injurious acids are often set free from their combinations in the soil by the action of plant roots, bacteria and fungi and by chemical changes brought about by the use of certain fertilizers, like the acid of superphosphates. In all those cases a liberal addition of lime to the soil acts as a cure to the injured plant and corrects the acid condition.

Alkali Soils.— In some cases, on the other hand, there is too much lime or other alkaline material such as carbonate of soda, etc., in the soil. The root hairs and feeding roots are killed by a sudden rise of a soluble alkali, or they may die a slow death if there is too much lime. It is a curious fact that a liberal addition of gypsum tends greatly to reduce the injury in both these cases and to raise the limit of endurance of most crops of alkali. Where alkalis cannot be washed out of soils through proper drainage, much can be done by breeding and selecting varieties of plants better adapted to such conditions. Great progress has already been made in this direction with alfalfa, sugar beets, cereals, date palms, etc.

Soil Nutrients.— Every green plant requires for its healthy development, besides water, oxygen and the CO_2 of the air, a certain proportion of nitrogen in the form of nitrates or ammonia, a salt of potassium and of phosphoric acid, available calcium and magnesium in about equal proportion, sulphur and a trace of iron and chlorine. If these are not available to the plant in the right form or ratio, or if any of them is too greatly in excess or lacking, a diseased condition of the plants in such soils quickly develops.

Nitrogen.— Lack of nitrogen in available form causes a proportionately diminished vegetative growth, light green or yellowish leaves, even where there is abundant moisture and other nutrient materials. An excess of nitrogenous fertilizer, on the other hand, causes various pathological derangements. Abnormal vegetative growth at the expense of flowers and fruit thus inducing temporary sterility is one of the commonest results of a food containing too much nitrogen in comparison with potassium and phosphoric acid. The tissues in such cases are likely to be soft and watery, easily injured by unfavorable temperature or moisture conditions as well as by insect and fungous parasites.

Tissue degeneration is in many cases the result of overfeeding with nitrogenous fertilizer. This appears to be one of the commonest causes of "die back" or gummy degeneration of the orange. Peaches and plums also suffer from a similar malady from the same cause. Large gum pockets develop in the wood as a result of the degeneration of the cells. The movement of water and food materials in the plant is greatly interfered with. The wood does not mature properly and as a result winter kills, or it is destroyed by insect and fungous parasites.

Phosphoric acid is an important constituent of every living cell, entering largely into the composition of the nucleus. Its reduction below the cell requirements is followed by a cessation of cell division and growth and in green cells by disorganization of the chlorophyll which first becomes reddish, then yellow. These latter changes take place first in the maturer leaves, then in the younger parts. An application of phosphates or superphosphates usually promptly corrects these pathological conditions.

Potassium also is required in considerable quantity by all plants. One of the first signs in a plant of a lack of available potassium is a decided cessation of growth without other apparent cause of trouble. During the early stages of potash starvation the plants often retain their normal green color. In later stages very little starch or sugar is made and almost no protein or nitrogenous matter. Unless the missing element is supplied the plants finally become yellow and slowly die. Potassium hastens and perfects the maturing of plants, especially the ripening of the wood of perennial plants, making them less liable to winter injury.

Calcium.— Lack of this element in plant nutrition is first indicated by a more or less marked yellowing of the young leaves due to a reduction in number and size of the chloroplasts though the chlorophyll itself may be normal. The starch made by the chloroplasts is converted with difficulty into sugar. This retardation is probably due to the fact that in calcium starvation the production of the starch transforming enzyme (diastase) is greatly reduced.

Magnesium.— While this element does not appear to be of such fundamental importance to the vegetable cell it is nevertheless absolutely required, especially during the periods of flowering and fruiting. A very small amount may often suffice to meet the requirements of growth up to the flowering period, but at this time a decided lack of magnesium results in the failure to set fruit or its failure to mature. With a more decided lack normal vegetation soon ceases, proleptic shoots develop with shortened stems, small, distorted, yellowish leaves crowded together in rosettes somewhat resembling potash starvation except in color.

It appears to be necessary that magnesium and calcium always be associated in plant cells except in some of the lower classes of plants. The ratio of one part of magnesium to three of calcium is the most favorable in many cases though this is quite variable for different species. In a large number of cases an excess of magnesium over calcium results in greatly retarded growth and an early death of the cells.

Both magnesium and calcium oxides (lime) play a secondary part in the soil by combining with the acids set free by root action, fermentations and other biological and chemical processes. If these were not at once combined the root hairs and feeding roots would be injured or killed and the plant would suffer from general starvation if not actual poisoning.

Sulphur.— This element usually absorbed by plants in the form of sulphates is one of the absolute requirements of all organisms. It enters into the structure of protoplasm and the more highly organized nitrogenous foods, proteids, required as the direct food of growing cells. Its abnormal reduction results in the cessation of proteid manufacture and consequently causes proteid starvation. Growth ceases and death follows unless the element in some available form is supplied.

Other elements and compounds are often important to the plant though not required. Silica for example is found very commonly deposited in the cell walls of plants, especially in the epodermal cells of cereals and grasses. Its presence stiffens the stems and leaves and in a measure protects them from biting and sucking insects and other small animals. Aside from decreased resistance to such attack a plant grows as well without silica as with it.

Chlorine.— This element in very small quantity appears to be necessary to the vigorous growth of plants, especially during the formation of flowers and fruit. In excess it is usually injurious except to plants adapted to soils rich in chlorides, such as sugar beets, asparagus, celery, etc. It is an interesting fact that sugar beets and celery are rendered much more resistant to spot diseases caused by Cercospora when well supplied with sodium chloride, than without it. Why this is so has not been determined.

Iron.— A small amount of this element is necessary to the formation of chlorophyll. An insufficient amount of iron is indicated very quickly by the formation of chlorotic or white leaves which become green on the addition to the soil of a soluble iron salt, such as iron sulphate. Often the failure of a plant to obtain iron is due to the death of the root hairs and feeding roots from various causes, alkali or acid, excessive moisture or dryness, insect or fungous attack, etc. In such cases, however, there are indications of general starvation as well as of lack of iron, and the diseased condition can be cured only by removing the cause of the death of the roots.

Atmospheric Conditions.— The close coordination between the conditions affecting the plant in the soil and atmosphere is at once apparent. In most of our ordinary plants, water, with various materials in solution, is absorbed by the roots from the soil and passes up through the stem to the leaves and other parts above ground. From these there is a continual loss of moisture, regulated in part by the plant, but depending largely upon whether or not conditions of the atmosphere, light, etc., favor evaporation, or transpiration as it is more correctly termed where living plants are under consideration.

Moisture Variation.— Plants growing in soil and air uniformly moist have smaller root systems and a larger total leaf surface than they would have if grown under constantly varying conditions of soil and atmospheric moisture. A plant reared in a moist greenhouse will gradually shed its older leaves if the air is allowed to become too dry or the plant is removed to an ordinary dwelling-room. The new leaves that develop under such circumstances are adapted to the drier air and are better able to retain the water furnished by the roots. If, however, the change from moist to dry is too sudden, the defoliation will be excessive and the new growth may develop very slowly and be poorly nourished. In the case of house plants there is almost a universal tendency to over-water the plant at such times. This brings on suffocation and death of the root hairs and feeding roots, and ends in death of the plant. Instead of watering under such conditions the soil should be allowed to become comparatively dry until renewed growth of leaves create a demand for water from the roots.

Plants which have been growing for a considerable period with a comparatively small water supply develop a large number of root hairs and firmer and smaller leaves adapted to reduce transpiration to its lowest terms. If a cloudy, wet period suddenly follows, or the plants are over-watered, they become gorged with water. The more plastic tissues start into growth, with the result that the leaves often become distorted, wrinkled, curled or twisted. If there is a continued excess of moisture many of the root hairs and finer roots may die, and symptoms of root suffocation develop, the leaves become spotted with yellow and finally drop off.

Œdema is a pathological condition characterized by the formation of water blisters or warts on the stems or along the vascular bundles of leaves over-gorged with water. This diseased condition often develops in plants growing in moist situations, especially under conditions where the soil is likely to be warmer than the air, thus favoring absorption of water by the roots, but not favoring transpiration through the leaves. The disease often develops, also, in extended periods of moist, warm, cloudy weather.

Burning or Scalding.— The growth that plants make under cloudy, moist conditions is often watery and soft, an easy prey for parasitic fungi and likely to dry out, wilt and die easily if suddenly exposed to clear, hot weather. Such "burning" or "scalding" of the edges and tips of leaves is very common in the spring, when moist, cloudy periods are suddenly followed by clear, hot days.

Wind often causes injury by whipping and tearing the leaves or breaking limbs. In the latter case injuries are produced which predispose the plant (especially trees and shrubs) to attack by insects or fungi. Wherever possible all such injured parts should be cut out to uninjured tissue and protected by antiseptic washes or grafting wax. Dry, hot winds coming early in the summer often cause the death of tender foliage by desiccation.

Injurious Gases.— Slight traces of illuminating gas escaping in rooms or greenhouses, or the slightest trace of sulphurous fumes from burning coal from furnaces or stoves, is extremely injurious to vegetation. The presence of these gases in the atmosphere causes the gradual yellowing, browning and finally the death of leaves, especially the tips and edges. Although the soil, temperature and light conditions may be the most favorable, the plants gradually die where they are more or less constantly exposed to a trace of these gases. In the neighborhood of factories or large cities vegetation is often injured, as described, by these and other poisonous gases. In some cases the amount of poisonous gas thrown into the air with the smoke from certain factories is so great that vegetation of all kinds is unable to thrive in the neighborhood. The injury extends often several miles from the factory in the direction of the prevailing wind.

Temperature.— Many predispositions to disease, as well as specific pathological conditions, are produced in plants as the result of unfavorable temperature conditions. As a rule, when growth is taking place and the cells contain much water, vegetation is most sensitive to heat and cold. When growth has ceased and the tisses are mature or in a resting or dormant condition and contain much less water, they are least sensitive to heat and cold. The temperature range for any individual during growth, and even in the dormant or resting condition, varies for different individuals, varieties and species. These temperature ranges have become more or less fixed within certain limits for different individuals and species through the influence of the temperature factor in the environment under which the species or individuals have developed. Thus, plants adapted to long growing seasons of the South will not thrive in the shorter, colder season of the North. On the other hand, many plants adapted to Northern conditions do not thrive in the South. When an individual or a species becomes adjusted or accustomed to the conditions and changes of a particular environment it may be unable wholly or in part to adjust its life processes to an unusual change in any factor or group of factors or the relation of these to each other. The orange, lemon, lime and numerous other subtropical fruits, for example, do not have a well-defined resting or dormant period like the apple, pear, peach, etc., in the North. They would, therefore, be quickly killed if exposed to severe frosts.

Certain varieties of peaches and plums which survive Northern winters without injury, when planted in the South often winter-kill. Extended warm spells in the latter part of winter, and the warming effects of the sun on the south and southwest sides of the trunk start the activity of the cambium, which is subsequently injured or killed by freezing, the same as are young buds pushing out too early in the spring under the influence of warm days and when caught by the late frosts.

Varieties that start into growth readily under such conditions may be completely winter-killed if the conditions are such as to stimulate a general premature activity. If only the tissues warmed by the direct action of the sun are involved, patches of various sizes may be killed. These usually start near the surface of the ground on the southwest side of the tree and extend up the trunk to the limbs, varying in width from a few inches to the whole south and southwest side.

Winter Sun Scald.— This term is usually applied to cases like those just described where smaller areas on the south or southwest side of trees are killed during winter by the successive warming and freezing of the tissues. This form of injury is common in the North and West. Considerable protection may be afforded in all such cases by coating the tree with whitewash or protecting it from the direct action of the sun in some way.

Winter Desiccation.— Evergreen trees and shrubs are often killed or greatly injured during periods of bright warm weather in the winter by rapid evaporation of water from the leaves while the ground and roots are frozen and unable to replace what is lost.

Another form of winter desiccation is through the direct action of freezing, where, by intense cold, the water is drawn so completely from the protoplasm into the cell walls or intercellular spaces in the formation of ice crystals that the cells are unable to reabsorb water on thawing. This effect of freezing is similar in many respects to that of drouth. Water is withdrawn from the protoplasm to a greater or less extent, according to the duration and severity of the cold and the retaining power of the protoplasm. If the withdrawal has not been too great and thawing process is slow so that the cells can gradually reabsorb what was given up in freezing, the plant may suffer no harm. If on the other hand, the tissues are thawed rapidly, the air is driven out of the intercellular spaces and the cells may die for want of oxygen or the water may be lost by evaporation before it can be reabsorbed. Frozen plants should, therefore, be thawed slowly and protected from evaporation by sprinkling with cold water or shading. While most cases of injury from freezing are due to the conditions just described, there is another class of cases where the injury is apparently due to structural and chemical changes in the protoplasm induced by the cold.

Cold Rigor.—As already pointed out, the sensitiveness of protoplasm of various plants and at various stages of growth differs remarkably, but in all cases during vegetative activity there is a point either a little above or below the freezing point of water where protoplasmic movement and growth cease without the cells being necessarily frozen or killed. This condition is known as cold rigor and is often taken advantage of by florists and gardeners in holding their flowers or fruits temporarily in some particular stage of development for a particular market period. Uusually when the temperature is raised the growth continues normally, but occasionally, if the temperature is a little too low and long continued, the plant fails to respond again to a higher temperature and is found to be in a state of permanent rigor or paralysis; though the plant does not die, it makes little or no growth.

Mechanical Separation of Cells.— In many parenchymatous tissues, leaves, bark, parenchyma, fruits, etc., which can stand considerable freezing without injury to the protoplasm, there is more or less rupture of the cells from each other by the formation of ice in the cell walls or intercellular spaces. In some cases the epidermal cells are almost completely separated from the rest of the tissue. In other cases, as in apples and bark parenchyma, the individual cells may, in extreme cases, be separated and form a powdery mass. If the separation is complete the cells die after a time. In any case, even a partial separation and breaking of the protoplasmic connections between the cells interferes with normal development, and may cause the premature death of the whole or parts of the plant by interfering with the movement of food materials, etc.

Frost-cracks.— These usually occur as the result of rapid freezing and shrinking of the outer tissues of trees, especially while the inner tissues are relatively warm. After the cold period is over and warmer weather comes such cracks close up.

Frost Canker.— This name is applied to wounds that are prevented from healing through the action of late frost in killing the callus rings as they develop. The killing of roots and the lifting of plants from the soil by freezing are familiar phenomena to all gardeners, but further consideration of this subject cannot be undertaken here.

Scorching or Burning.— Sometimes in hot, dry weather smooth-barked trees and shrubs may have portions of their tissue exposed to strong sunlight actually killed by the high temperature. In light-colored, sandy soils the reflection of heat from the sand often kills the lower leaves of low-growing trees, shrubs and especially of herbaceous plants. The reflection of sun heat from the south or west side of buildings, etc., may also cause similar injury. The direct injury in such cases is often, however, confused with the effects of excessive transpiration. The burning effect of hot, dry winds is largely due to the excessive transpiration they induce. The burning is especially severe when there is an insufficiency of soil moisture as the result of drouth or lack of proper cultivation.

Sudden Variations of Temperature.—As already indicated, the injury resulting from changes of temperature above the maximum or below the minimum for a species or individual depends in large measure upon the rapidity of the change. If the change is slow, even the individual plant may adjust its vital processes to temperatures which would have resulted in death had they been sudden. Some of the algæ, for example, live in hot springs at a temperature of 93° C., while the original stock from which these forms were derived lives in water rarely exceeding 40° C. A transfer of individuals from 40° to 93° would result in almost instant death, while by slow, gradual change they could be accustomed to this extreme temperature. For flowering plants (Phanerogams) the possible maximum is much lower, 50° being the extreme limit, while the average limit is from 37° to 46°.

Sudden variations well within the fatal limits, however, are productive of pathological changes. A rose, tomato, violet or almost any other plant grown at a cool temperature (8° to 15° C.), all other conditions remaining the same and then suddenly exposed to 24° to 27° C., will turn yellowish, become weak and spindling and very sensitive to insects and parasitic diseases. The same plants, started at 24° to 27° and growing normally at that temperature, if suddenly dropped to 15° or 8° become yellowish and weak and very sensitive to parasite enemies. In either case the change from one temperature to the other could be made without serious injury if made gradually and slowly. For a general discussion of this subject with references to literature, consult Davenport's 'Experimental Morphology.'

Resting or Dormant Period.—A resting or dormant period is more or less well defined in many perennial plants. In northern and temperate latitudes this period coincides with cold weather and has developed in response to this constantly recurring seasonal change. In other cases in hot climates a partial rest may occur during the dry season. In many cases this period of rest has come to be a necessity to the normal and healthy development of the plant. Detmer and Müller-Thurgau have shown in the case of potato tubers and many dormant buds that in the fall and early winter the tissues contain only enough sugar to meet the demands of respiration of the dormant cells, not enough to stimulate growth. Müller-Thurgau has dem-

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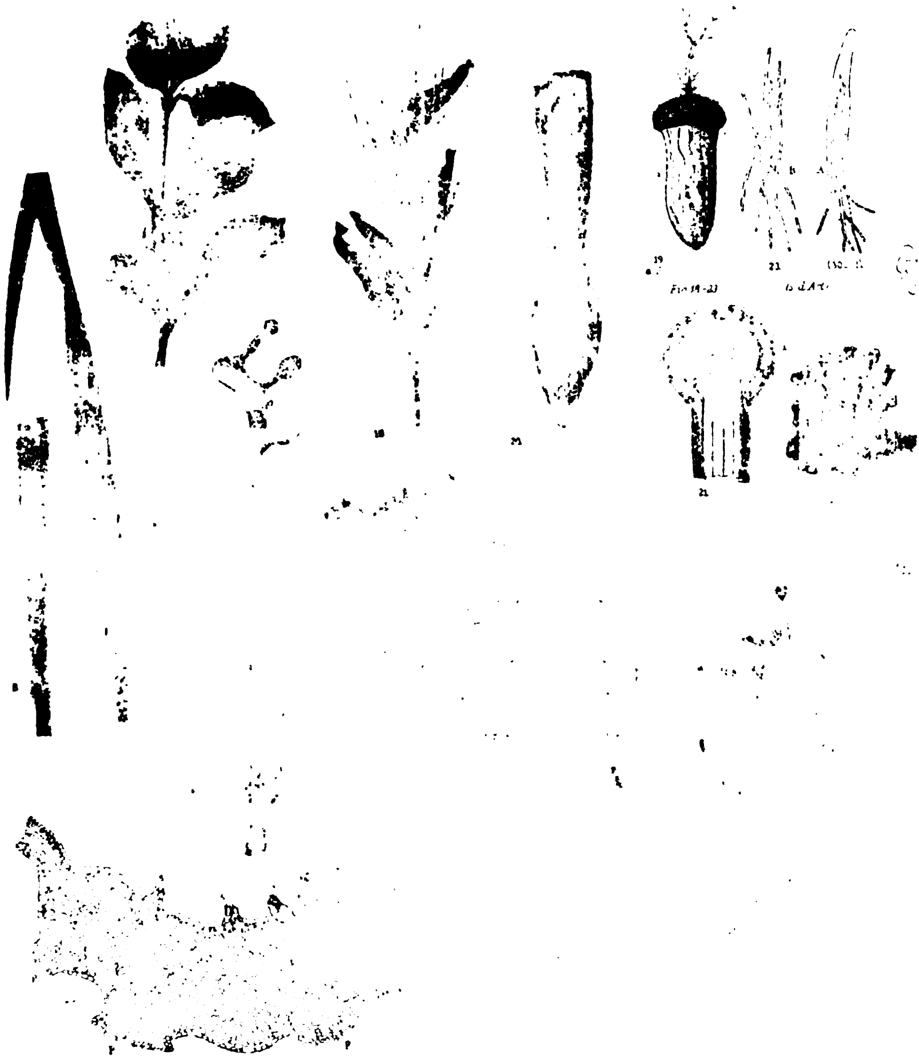

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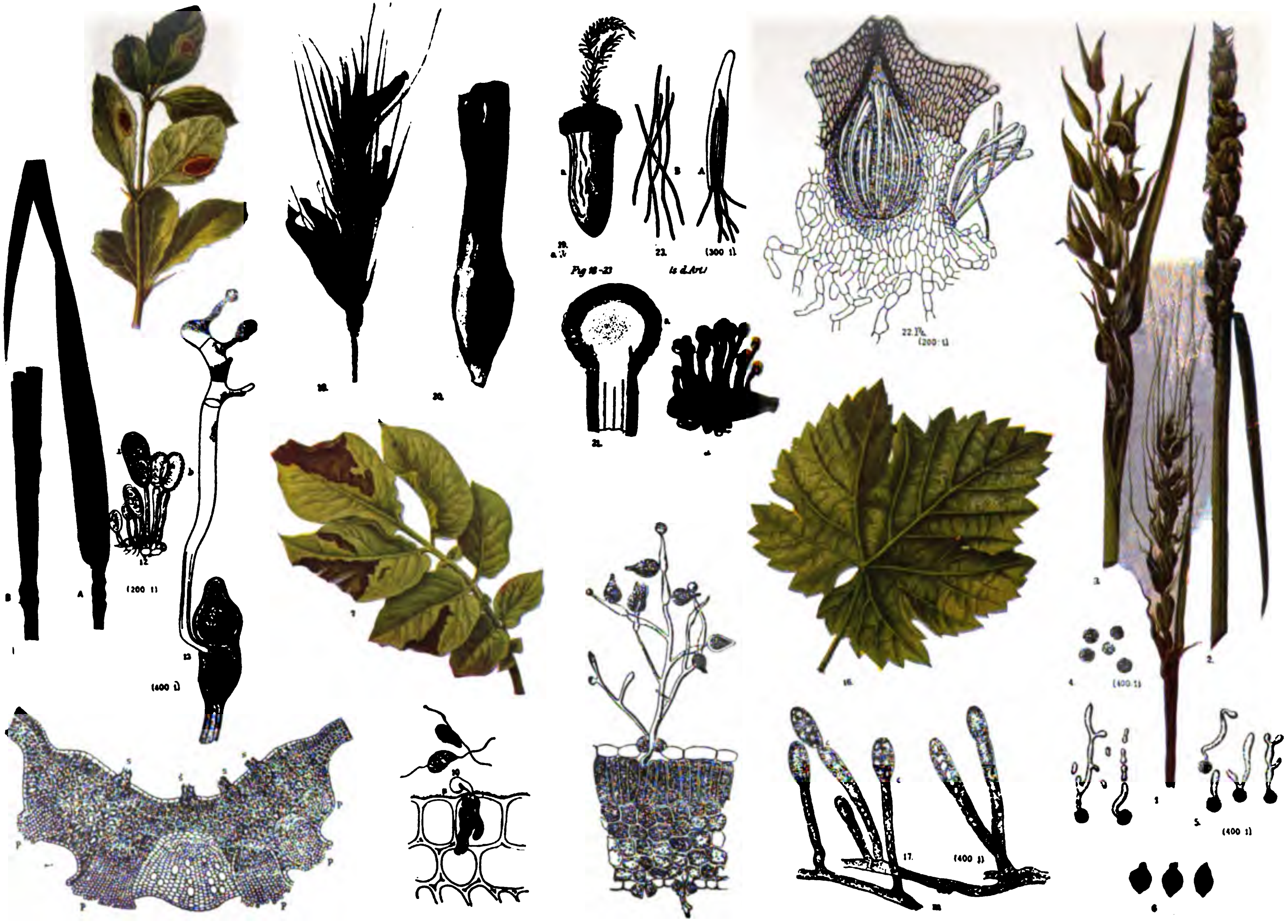
[illegible]**ing or Burning.** — Sometimes in [illegible] smooth-barked trees and [illegible] portion of their tissue exposed to [illegible] sunlight actually killed by the high tem- perature. In [illegible] discolored, sandy soils the re- [illegible] of heat from the sand often kills the [illegible] leaves of low-growing trees, shrubs and especially [illegible] herbaceous plants. The reflected [illegible] from the south or west side [illegible] may also cause similar inj[illegible] injury in such cases is often [illegible] with [illegible] effects of exc[illegible] The burning effect of hot [illegible] by [illegible] the excessive tran[illegible] epidermis, is especi[illegible] an insufficiency [illegible] out of drouth or [illegible]

Sudden [illegible]ons of Tempera[illegible] — As [illegible] they [illegible] for exa[illegible] springs at [illegible] temperature of [illegible] which [illegible] in which [illegible] lived live [illegible] A transfer [illegible] individuals [illegible] to [illegible] and result [illegible] almost [illegible] to the [illegible] lowering [illegible] maximum is [illegible] limit, wh[illegible] [illegible] than the latter [illegible] pathol[illegible] or almos[illegible] temperature [illegible] remaining [illegible] to 24° to 2[illegible] are weak and [illegible] to insects and par[illegible] plants started at 24° to [illegible] growing normally at that temperature, suddenly dropped to 15° or [illegible] become yellow and weak and very sensitive to parasite [illegible] In either case the change from one tempera[illegible] to the other could be made without se[illegible] injury if made gradua[illegible] and slowly. F[illegible] general discussion of [illegible] subject with ref[illegible]ences to literature, [illegible] Davenport's [illegible] perimental Morpho[illegible]

Resting or Dorm[illegible]od. — A resting or dormant period is [illegible] well defined [illegible] many perennial plants [illegible] northern and tem- perate latitudes th[illegible] coincides with cold weather and has [illegible] in response to this constantly recurring [illegible] al change. In [illegible] cases in hot clim[illegible] nal rest may occur during the dry [illegible] in many cases this period of rest [illegible] be a necessity to the normal and [illegible] ement of the plant. Demot [illegible] and M[illegible] have shown [illegible] the case [illegible] many dormant buds that [illegible] winter the tissues contai[illegible] to meet the demands of [illegible] nt cells, not enough to [illegible] Thurgau has dete-

DISEASES OF PLANTS



1-6. Brand-fungi (Ustilagineae) of Oats and Wheat, with Spores. 7-10. Potato Rot. 11-15. Rusts, showing effects on leaves. 16. Leaf affected by Hymenomycetous Fungi (Oidium). 17. Oidium-Growth. 18-23. Ergot-fungus, showing development and effects.

onstrated that exposure of tubers dug in August to 0° C. for a few weeks causes an accumulation of sugar sufficient to start normal germination when the cooled tubers are placed under favorable conditions. The cold reduces the amount of sugar used in respiration and probably also causes an increase of diastase, the enzyme that converts starch into sugar. The same has been shown to be true also in the case of the dormant buds of many trees and shrubs. Exposure of dormant buds, bulbs, tubers, etc., to sulphuric ether for several days has a similar effect to that produced by exposure to cold. In the case of plants that have their dormant or resting period in dry weather there is an accumulation and modification of reserve foods preparatory to the next season of growth. Buds, bulbs and tubers may often be forced to grow before they have accumulated sufficient reserve food in the proper form, but the result is usually a weak plant very subject to disease. A good example of this may be seen in the attempt that is often made to force bulbs that are immature and that have not had their normal period of rest or have been forced the previous season. Variegation or mosaic disease is also often produced in this way.

Light.— Practically all the chlorophyllaceous plants are dependent upon sunlight for normal development and activity. Every individual and every species is adapted or attuned to a particular range of light intensity and suffers injury if the intensity becomes too great or too small, or if the change from one intensity to another is too sudden.

Injury from Strong Light.— Many bacteria and fungi, for example, *Bacillus anthracis* and *Botrytis cinerea,* grow best in darkness or very weak light, but are killed in a short time by exposure to sunlight or to artificial light strong in the blue-violet rays. It is this portion of the spectrum that causes the chemical disorganization of the protoplasm or rather its destruction by oxidation as in the absence of oxygen during exposure no change takes place. The same is true of the more highly developed chlorophyllaceous algæ and shade plants — too strong light not only destroys the chlorophyll by oxidation induced by the blue-violet rays, but the protoplasm itself may finally be thus killed or chemically disorganized. This is also well shown in the injurious effect of the ultraviolet rays in the naked electric arc light. A glass globe which cuts off these rays prevents the injury. This pathological condition in varying degrees of intensity is produced not only in shade plants when exposed to direct sunlight, but also in other plants when grown in the shade and suddenly exposed to strong light. It is also common when an extended period of cloudy or foggy weather in the spring is suddenly followed by bright, clear days. Under such conditions there is not only a partial destruction of the chlorophyll, but an excessive loss of water from the poorly cuticularized leaves. Such leaves are also unable to close their stomata quickly, which is another reason for their suffering from excessive loss of water. The action of light in promoting evaporation or transpiration is mainly by raising the temperature of the tissues above that of the surrounding air. When the air temperature is very high the increased temperature of the tissues of plants exposed to strong sunlight is often sufficient in itself to cause injury or death.

Injury from Weak Light.— While too strong light cannot be endured by any plant, lack of light is injurious only to cholorophyllaceous plants. When the light intensity is reduced below the minimum for any of these plants the synthesis of carbon and nitrogen compounds is reduced accordingly until in very weak light or darkness the plant can make no use whatever of the carbondioxide of the air. That the plant will starve in proportion to the reduction in photosynthetic activity is evident.

Electricity.— That electrical conditions of the earth and atmosphere and of the plant have an important relation to the physiological condition of the latter has been demonstrated in many cases, but the full significance of this relation is not yet understood. Plants vary in sensitiveness to electric currents in much the same way that they do to light or heat. A current above the maximum for a plant causes the disorganization and death of the protoplasm. This is often accomplished by a comparatively weak direct or alternating current, but is perhaps most familiar in cases of injury or death from currents of high intensity, as from electric-light wires or lightning stroke.

Mechanical Injury.— Finally, among the causes of disease in the non-living environment, we have to mention mechanical injuries, such as those produced by hail, wind, falling trees, etc. Hail stones often severely cut and tear the foliage of trees and herbaceous plants and may also produce more or less serious wounds in the more resistant tissues. Wind may injure the foliage, break limbs, etc., as may also falling trees. In all these cases, except in the most severe forms, the greatest danger comes from the entrance into the tissues of the wounded plant of parasitic insects and fungi. Large mechanical wounds, however produced, should have antiseptic treatment where practicable, especially in large and valuable trees. The injured parts should be trimmed to healthy tissue in such a manner as to favor rapid formation of callus. After a wash of some disinfectant, such as copper sulphate 1 per cent solution in water, the wound should be protected by shellac or grafting wax or white lead paint.

DISEASES CAUSED BY THE LIVING ENVIRONMENT.

Struggle for Room.— The results of crowding are so familiar and apparent that discussion of the subject is scarcely required. The strong plants occupy the soil with their roots and the air space with their leaves and branches, crowding out the more backward or weaker individual or species. Some are thus starved to death, others are reduced in size and vigor according as they lack the proper space in which to grow.

Plant Associations.— Plant associations spring up controlled by certain dominant species. Each individual of such a community has its influence on the others. The shade of a tree keeps back some sun-loving species and makes it possible for shade-loving species to grow, and so, with countless inter-relationships, plant communities develop, often of great complexity. If the tree or other dominant factor is removed the changed conditions are followed by a breaking-up and readjustment according to the new conditions. Many of the former occupants of the area will be starved or crowded out in the struggle. Others may suffer from excess of light or too high temperature. Disregard of the natural requirements of plants and their inter-relations in communities often leads to disastrous results in clearing or planting in landscape gardening.

Symbiosis.— This term was first used by De Bary to designate plant partnerships such as those represented by the co-operation of fungi and algæ in the formation of organisms known as lichens. The fungous hyphæ surround the algæ cells and furnish them with water and dissolved salts from the substratum, and the algæ in return supply to the fungus hyphæ the required organic nutrient materials. The community forms in itself a specific vegetable organism, though under favorable conditions of nutrition both the fungus and the algæ forming the lichen may live independently of each other. Another type of symbiotic relationship is found in the so-called *Mycorhiza* or fungus roots. These are specially common on plants growing in humus. Two types are distinguished, one where the fungus is in close external union with the roots, covering them with its filaments and preventing the formation of root hairs, actually taking their place by supplying the plant not only with water and mineral food but also with organic nutriment from the humus. These external associations are usually termed ectotrophic mycorhiza.

Monotropa hypopitys is a good example of a non-chlorophyllaceous plant dependent upon ectotrophic mycorhiza for its food. Among forest trees the phenomenon is very common especially in the *Cupuliferæ* and *Abietineæ*. That the fungus mantle in these cases supplies the host with food materials from the humus has been amply demonstrated. Ordinarily the host plant in these cases furnishes little or nothing to the fungus, which is able to obtain all its nutriment from the humus. In some cases, however, the mycorhiza fungus has been observed to penetrate the root sheath and become parasitic. It is a short step from this condition to the cases where the fungus is normally internal, forming the so-called endotrophic mycorhiza, as in many of the *Orchideæ, Ericaceæ, Epacrideæ, Empetraceæ* and representatives of other groups living in humus soils. In many of these cases, while the plants are not in any way apparently injured by the fungus, they can thrive as well without as with it, and the relation of the fungus to the host has not as yet been fully investigated. Among the *Leguminosæ*, however, the case is different. All legumes in their native soils have their roots covered with «tubercles.» These develop as the result of stimulation produced by certain bacteria which enter the young roots through the root hairs and grow symbiotically within the cells. The bacteria draw their organic nourishment from the stores in the root and in return secure nitrogen directly from the atmosphere which afterward becomes available to the legume. Legumes with these tubercle bacteria can thrive in a soil absolutely devoid of nitrogen, whereas, without the bacteria, they could not live at all in such a soil. The failure of legumes to thrive in certain soils is often due to the absence of these tubercle organisms. On the other hand, the tubercle organism often degenerates into a mere parasite. Similar organisms are also found in symbiotic relation in the alder and in several other groups of plants.

Vegetable Parasites.— The true vegetable parasites (obligate parasites) are those which cannot, in any phase of existence or stage of development, live independent of the host plant. There are many true parasites both among the higher and lower orders of plant life. Many organisms, however, are parasitic during certain stages of their development and saprophytic in other stages; where the parasitic nature is predominant they are called hemi-parasites; if the saprophytic phase predominates they are classified as hemisaprophytes. All of these classes are responsible for the production of diseases of various types. The true saprophytes, which live entirely on dead organic matter, are seldom the cause of diseases. The disease of plants due to vegetable and animal parasites constitute by far the larger number of diseases and are those of greatest economic importance. In some cases, as previously suggested, it is difficult to determine whether we are dealing with a harmless symbiotic relationship or one where the host is more or less injured. In this doubtful category, for example, are to be placed the mistletoes (*Loranthaceæ*). These plants possess leaves containing chlorophyll and are related to their host the same as a scion to a stock. The true mistletoe of Europe (*Viscum album*) and its relatives in America (*Phoradendron flavescens*) are parasitic on a great variety of deciduous trees and sometimes do considerable damage. Here also must be placed those endotrophic mycorhiza of many plants growing in humus where neither benefit nor injury has been shown as a result of the presence of the fungus in the roots. Among the phanerogams, however, there are many true parasites, for example, the *Orobanchaceæ*, which are devoid of chlorophyll and derive all their nourishment from the roots of the host plants to which they are attached. These parasites often do considerable damage to tobacco, hemp, lucerne, clover and other crops. The Dodders (*Cuscuta*) are also true phanerogamic parasites, deriving all their nourishment from their host plants, which they overrun and penetrate with their sucker roots (haustoria). The most dangerous and prolific disease-producers, however, are the pathogenic fungi and bacteria.

Pathogenic Fungi.— The consideration of diseases caused by pathogenic fungi is usually based upon the fungus and the genetic relationships of the fungi usually determine the order in which the diseases are discussed.

While this practice is undoubtedly the best one to follow in a systematic treatise, it is probably the cause of the erroneous impression sometimes encountered that the fungus is the disease. The disease is the functional or cell derangement of the plant or part of the plant. The same functional or cell derangement and, therefore, strictly the same disease, may in some cases be produced by a great variety of totally unrelated causes. More attention should be given in plant pathology to the study of the disease itself; though not less attention should be paid to the determination and study of the cause. This latter course is especially necessary in the case of the pathogenic fungi, bacteria or insects. A complete and accurate knowledge of the life history and nutritive requirements of pathogenic organisms furnishes the best foundation on which to base the procedure for preventing or controlling the diseases caused by them. As already suggested, there is every possible gradation among the pathogenic fungi, between the strict saprophyte (such as sooty molds), causing disease only by chance association, and the strict parasite (such as rusts and smuts), unable to exist independently of their living hosts.

Among the diseases caused by strict saprophytes may be mentioned the starved and chlorotic condition of many leaves and fruits due to the presence of sooty molds on their surface. These black, mold-like fungi grow in sugary excretions, especially the "honey dew" excreted by insects, aphides, scales, leafhoppers, etc. This black growth, where it covers the surface of leaves, occasionally cuts off so much light that the chloroplasts lose their green color, and the formation of starch and sugar is so greatly reduced as to cause partial starvation and general retardation of growth of the whole plant. This is intensified by the injury produced and the food removed by the insects.

Many of the saprophytic yeast fungi, molds and bacteria cause fermentive decomposition in the weakened and dead cells of the wounded tissues, especially those rich in sugar or other reserve materials. Toxic products are thus produced which weaken or kill all the cells absorbing them. Such fermentations are especially common following mechanical injury to ripening fruits and to the sapwood of trees, in the latter case particularly following the work of borers. Fungi of this class grade imperceptibly into the hemisaprophytes or facultative parasites which start their vegetative development in dead or weakened tissues like the heartwood of a tree or the dead tissue of a wound, and then gradually spread into the living tissues, killing them. The best examples of this class are the wood-destroying *Polyporeæ* (bracket fungi), *Agaricineæ* (toad stools), and related fungi. When these get into the heart-wood through a wound, or into an area of dead cambium bark or sapwood, they first kill the dead area with their mycelium and gradually spread into surrounding living tissue, in some cases by secondary action through decomposition products, or by cutting off the water or food supply from the living tissues, or by primary action, where the mycelium spreads from its saprophytic vantage ground directly into the neighboring living tissue.

In order to prevent wound infection of woody plants it is necessary either to keep the surface of the wound dry, preventing the exudation of sap and the entrance of water by searing with a hot iron, or by treating the injured surface with an antiseptic or protective coating, paint or wash, such as coal tar, white lead, copper sulphate, etc.

Besides the hemisaprophytic wood-destroying fungi which gain entrance through wounds and are not able otherwise to infect a sound plant there are others of the same class, such as *Agaricus melleus*, whose mycelial strands or rhizomorphs are able to work their way through the sound bark of numerous conifers, underneath the bark and in the wood of which the fungus produces dense white, felt-like mycelial membranes. These kill the bark and wood and stimulate an excessive flow of resin into the injured parts, finally resulting in the death of the tree. This same fungus also attacks deciduous broad-leaved trees, but here it is more particularly a wound parasite.

Botrytis, Pythium, Sclerotinia and many other fungi, though able to pass the whole of their existence as saprophytes, are also able under favorable conditions to infect the living tissues of plants and destroy them. It is a short step from these fungi to those of a slightly more decided parasitic nature, the *hemiparasites*, organisms which cannot in nature complete their life history as saprophytes. The *Ustilagineæ* (smuts) are among the most familiar examples of this class. These grade imperceptibly into the strict parasites such as the *Uredineæ* (rusts), which cannot live at all as saprophytes.

Among the strict parasites there is often a high degree of specialization, a given species of fungus being restricted in many cases to a particular genus or even species of plant. In some of the rusts there is a peculiar phenomenon of this nature known as heteroecism. Many species of rusts go through their whole life history producing all their various forms of spores on the same host. In other cases, however, spermatia and æcidiospores are produced on one host and the uredospores and teleutospores of the same fungus are produced on an entirely unrelated host.

Injury Caused by Parasitic Fungi.— It is extremely difficult to classify the various reactions of plants to parasitic attack. Every case has to be considered in a large measure individually. There are, however, certain general types of reaction and injury that may be noted. There are many parasitic fungi, for example, that attack the leaves of plants; some of these, like the powdery mildews, grow only on the surface of the leaves and younger stems, forming powdery, whitish spots or coatings and drawing nourishment from the surface cells by sending down into them short, root-like growths, *haustoria*. When these surface parasites attack the young growing leaves, stems or fruits, the areas occupied by the fungus are greatly retarded in development, often causing more or less distortion of the leaves, and in severe cases often killing them and causing early defoliation. The flowers and fruit may thus also be destroyed. The proper ripening and maturation of the wood of perennials is often so much retarded by these direct and indirect effects that it winter-kills. When these fungi, however, attack only a few leaves on a plant, or where they attack the leaves after they are full grown, the injury is comparatively slight. Prompt burning of the fallen leaves in autumn is one of the best preventive measures. Sulphuring, so widely practised in the case of vine mildew, helps to rid plants of the fungus, and spraying with Bordeaux mixture is a good preventive as well as curative treatment.

Besides these external parasites there are a large number which penetrate and vegetate directly in the cells or in the intercellular spaces of the host. Some of these after a time kill the tissues in which they are growing, producing a dead area. If these dead areas are in the leaves and are numerous or large, the value and working power of the leaf may be seriously impaired or destroyed altogether. The destruction of the first crop of leaves often results from the attack of leaf-spot fungi early in the summer, and the plants are obliged to put out a second crop of foliage. This must be done at the expense of reserve food stores. In such crops as sugar beet, Irish potato, etc., this use of reserve food becomes evident in the reduction of yield of tubers and sugar. In crops like beets and potatoes, where there is a continual succession of new growth, a second attack is not so serious as in the case of trees and shrubs where two successive defoliations either kill the plant outright or so weaken it that it winter-kills or dies of starvation. The weakening effects of premature defoliation are often not fully realized. Where one premature defoliation has occurred from any cause, great effort should be made to protect the second crop of leaves and to stimulate the plant with nitrogenous fertilizers. If the plant is a perennial, some protection, if possible, should be furnished during winter, as the wood is likely to be poorly ripened. Practically all the leaf-spot diseases are easily controlled by spraying the foliage with Bordeaux mixture or other good fungicide. Immediate removal, if possible, and burning of the diseased leaves also serve to hold these diseases in check.

If prompt action of this kind is taken when the trouble first appears it may often be checked without other treatment. It is safest, however, to spray the plants with a fungicide, whenever practicable.

Many fungi which may start by attacking the leaves are not limited to them, but spread to or even directly attack the stems. The *Peronosporeæ*, or downy mildews, are good examples of this class. Plants which have developed in moist, cloudy weather are particularly sensitive, and the parasite starting in leaves or stems may in a few days invade all the tissues of the plant, causing a rapid soft rot. The well-known "potato rot," often causing the complete destruction of the crop in a few days, is caused by one of this group of fungi. Many other crops are similarly affected by fungi of this group. Like the leaf-spot fungi, these are easily prevented from gaining entrance to the tissues of plants by keeping them well sprayed with Bordeaux mixture or other good fungicide.

The root rot and damp-off fungi — *Rhizoctonia, Ozonium, Agaricus melleus, Botrytis, Pythium, Fusarium*, etc., usually attack the plant through the roots or base of the stem, and cause a more or less rapid decay of the invaded tissues, followed by the starvation and death of the whole plant.

The cultivation of resistant individuals or the use of uninfected or sterilized soil and attention to general cultural conditions, especially rotation of crops, drainage and aeration of soil, are the best preventive measures for diseases of this type.

In other cases stems and leaves may be invaded by fungi (rusts or smuts), but rotting or sudden death of the tissues does not occur. The plants may, however, be so reduced in vigor that they fail to mature. The cereal rusts, for example, often greatly reduce the yield of grain. In case of the smuts the grain is replaced by the spores of the fungus, but the plant is apparently not otherwise injured.

Hypertrophy.— In some cases the tissues attacked by fungi are stimulated to excessive growth. Finger and toe disease of turnip roots caused by *Plasmodiophora*, plum pocket and "leaf curl," "witches' brooms," etc., caused by *Exoascus*, the large galls on *Vaccinium* and *Rhododendron* caused by *Exobasidium*, the large swellings produced on conifers by *Peridermium*, etc., are good examples.

Pathogenic Bacteria.— The casual relation of bacteria to numerous animal diseases has been the subject of much careful study, but until recently there were only a very few plant diseases known to be caused by these organisms.

Among the best known examples may be mentioned the "fire blight" of pomaceous trees, especially pear and apple. The tops of the trees are killed back as if burned by fire. The bacillus causing the trouble is carried from tree to tree by bees and other insects. The principal infection is through the nectaries of the flowers, and possibly, also, through the glands or water pores of the young leaves. The twigs are usually killed back for a few feet, then as the wood begins to mature the bacteria usually die, except where they have invaded a large limb or the body of the tree. To prevent the disease being carried over from season to season it is necessary only to find and remove all these latter sources of infection.

A bacterial disease of the English walnut on the Pacific Coast is a serious menace to the culture of these trees. A bacterial gall or tumor of olive trees is serious in Europe, and has appeared in some of the olive groves of California. Among the bacterial diseases of vegetables may be mentioned the bacterial rot of the tomato, egg plant and Irish potato, carried by biting insects, the brown rot of cabbages, and a bacterial disease of sweet corn entering the tissues through water pores in the edges of the leaves. Numerous other plant diseases have been shown to be due to bacteria, and the number will probably be greatly increased as the field is more carefully worked.

Diseases Caused by Animals.— Next to diseases of vegetable origin, those caused by animals, especially insects, are the most numerous and destructive. Many fungus and bacterial diseases are carried from plant to plant by insects; for example, pear blight by bees, potato rot by potato beetles, ferment and wood-rot fungi by boring beetles, etc. In the case of pear blight the bees, though they are carriers of the disease, are beneficial to the trees in aiding pollination. In other cases the injury caused by the insects may in itself be serious. The biting insects may in some cases cause more or less complete defoliation, or the sucking insects and mites may so reduce the stores of plant food as to seriously interfere with growth. Among the best known and most injurious of these are the scale insects, mealy bugs, plant lice (*Aphidæ*), leaf hoppers, and the "plant bugs" (*Capsidæ*). All of these feed on the sap of the plant by sucking it out of the tissues, but causing little or no mechanical injury to the cells. In many cases there is simply a general or local retardation of growth due to the removal of sugars and proteids; in other cases irritations are set up, possibly by some material injected into the tissues by the insect, resulting in gall-like swellings or various hypertrophied developments of the parts attacked, for example, *Phylloxera* on the leaves and roots of grape; woolly apple louse (*Schizoneura*) on roots of apple; *Colopha*, cockscomb gall on elm, etc. In other cases the growth of the tissue is checked, as where tissues are attacked by scale insects such as San José scale, and by many of the plant lice and leaf hoppers. In other cases growth is neither checked nor accelerated, but definite spots are produced which continue to enlarge, resembling a fungus or bacterial infection (*Stigmonose*) or puncture diseases, etc.

Borers may more or less completely ring a tree, cutting off the connection between root and leaves and thus resulting, in many cases, in death. Hypertrophy of tissues is also often the result of insect attack. Many insect larvæ developing from eggs laid in young tissues cause, by the irritations they set up, growths known as galls. Nematode worms attacking the roots of plants also cause gall-like swellings.

As in the case of the fungi, the complete life history and habits of any particular injurious insect must, as a rule, be determined before the greatest success in controlling it can be attained. Many insects have their natural enemies, which, if favored, may hold a serious pest in check. The development of natural resistance in plants by selection is also an important means of preventing injury in certain cases. And finally, the use of insecticides must be resorted to, as arsenic, etc., for biting and eating insects, and contact poisons for sucking insects.

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PLANTS, Embryology of. See EMBRYOLOGY OF PLANTS.

PLANTS, Fertilization in. See FERTILIZATION IN PLANTS.

PLANTS, Food of. Two classes of definitions have been applied to this term. Those formulated by agriculturists include all such substances as plants can assimilate from soil or air, anything adapted to form tissues and sustain the growth, functions and reproduction of plants, such as natural materials, manures or fertilizers. Botanists, on the other hand, exclude all these materials and limit their definitions to those substances elaborated or manufactured by and within the plant organism itself for building cellular or other tissue or cell contents. What the former considers as plant foods the latter calls plant food materials. Of the two definitions the first given is the most widely accepted because the most rational and satisfactory. From the agricultural standpoint the definition is generally extended to include those substances which supply perhaps only one element of their composition but which is essential to some function of the plants. Some of the elements secured are built into the cell tissue; others are contained in the protoplasm or other materials with which the cells are filled. When plant foods are readily taken up by plants they are termed *available foods*; when not easily assimilated *unavailable foods*. The latter must pass through changes of various kinds before they can become available. Without exception, however, both available and unavailable foods when secured by the plant from the soil must be in a form soluble in water.

In order to attain normal development every plant requires 10 or more substances which are called essential elements because the lack of any one will interfere with growth and development and in time prove fatal. These elements are carbon, hydrogen, oxygen, nitrogen, sulphur, phosphorus, potassium, calcium, iron and magnesium. The first four of these and sometimes the fifth and sixth are called «organogens» because they are considered as charasteristic of organic compounds. Besides the 10 elements mentioned most plants also contain silicon, sodium and chlorine, but these have not been proved essential; usually plants seem to grow more normally with than without them.

The physiological functions of these various foods have been largely determined by experiments but in some cases much remains to be discovered. A knowledge of these functions is of profound importance in crop production, especially since manuring, fertilizing, tillage and many other farm practices may be more intelligently carried on when they are understood. Briefly the principal rôles are as follows:

Carbon enters through the leaves where by means of photosynthesis (q.v.) it combines with water to form the foundation compounds of which starches, sugars, cell tissue and other carbon-containing organic substances are the final or resultant products. Thus carbon becomes the most important organic element, not only within the plant, but in nature, because all its naturally occurring organic compounds, whether in plants, or as assimilated by animals, or deposited as coal, oil or gas, trace back to it via nature's chemical laboratories in the leaves and other green parts of plants.

Oxygen ranks next to carbon as a constituent of the dry matter since it is in almost all plant compounds. It is also essential to respiration (q.v.), to oxidation of materials and thus to the development of energy in the growing plant. When combined with hydrogen in the form of water it is both the main solvent and the transporting vehicle for crude and elaborated plant foods dissolved in the «sap.» Water also performs several other functions in plants; for instance, maintaining turgor, reducing temperature through evaporation, etc.

Hydrogen enters into every organic compound excepting neutral oxalates in plants, yet because of its extreme lightness plants contain only about 6.5 per cent of it.

Phosphorus is largely used by plants to make proteins, cell nuclei, to stimulate growth of seedlings, increase root growth, divide cells, ripen the seed and to reduce the content of nitrogen in cereal seeds. When plenty of it is in the soil, especially during a dry season, plant roots are able to penetrate deeper than they could otherwise and thus tap surer sources of water. When applied as fertilizer in the drills of corn and other crops it stimulates the crop, as in the practise of the New England Indians who deposited a dead fish in each hill of corn.

Potassium is necessary to the manufacture of the carbo-hydrates in plants, for the hydrolysis of starch, the production of cell tissue to help give rigidity to stems, to help resist fungous diseases, strengthen leaf development, increase yields of potatoes, sugar beets and other crops rich in starches or sugars, to neutralize acids, produced by plant growth and to heighten the color of fruits.

Nitrogen is essential to the production of proteins, the formation of protoplasm, chlorophyll (qq.v.) and many other compounds. It stimulates plant tissue, especially of leaves which it makes large and dark green, as every market gardener can testify from his experience in using it upon cabbage, spinach, lettuce and other pot herb crops. Over-stimulation with it delays seed maturity, tends to make plants weaker stemmed and tender to frost and to disease, thus acting opposite to phosphorus and potassium.

Sulphur helps to make most proteins and many flavoring oils such as in onion, cabbage and mustard.

Calcium, like potassium, helps dissolve and transport starch, develops strong cell walls and root hairs, precipitates oxalic acid which is formed by plant activity and unless crystallized would poison the plant.

Magnesium aids the formation of chlorophyl, of proteins, the assimilation of phosphorus and the development of seeds presumably as a carrier of phosphorus in the plant.

Phosphorus and nitrogen migrate to the seeds during the ripening process so that there are often two or more times as much of these in the seeds at that time as in other parts of the plant. Potassium and calcium remain in the stems then to aid in assimilation — two or three times as much of the former and almost eight of the latter as in the seeds. Sulphur and magnesium are more uniformly distributed. Iron is largely in the green coloring matter.

About 75 per cent of the live weight of plants consists of water. The balance is termed «dry matter» which is either taken up or manufactured by the plant. It consists mainly of organic material in about the following proportions: Carbon, 11 per cent; oxygen, 10 per cent; hydrogen, 2 per cent. The balance includes the nitrogen, part in organic form and part in the «ash,» or residue left after burning. All of these ash elements are necessary in the formation though not part of the fundamental plant substance.

Foods reach the interior of plants in two ways, through the air and through the soil; practically all the carbon and much of the oxygen in the former and part of each combined with certain ash elements in the latter by which way also the other elements enter in the form of various compounds such as phosphates, nitrates, sulphates, carbonates, etc., always in solution. When taken up by the roots soil water becomes sap which passes from cell to cell till it reaches various kinds of conduits which direct it to the leaves and other parts of the plants, where needed.

The absorbing parts of the roots have a selective action which allows helpful substances to enter but to a greater or less degree prevents the entrance of phosphites, nitrites and sulphites, etc., which are not plant foods but plant poisons and so would prove harmful. This selective action is still more refined, for at times when the plant may be in special need of nitrates it will seize these but take up little or no phosphates, though the case may be reversed or both be equally absorbed at another time. Again the protoplasmic layer of the roots may appropriate the nitrate from nitrate of soda or some other salt by chemico-physiological processes but leave the undesired sodium in the soil. Consult Duggar, 'Plant Physiology' (New York 1911); Stoddart, 'Chemistry of Agriculture' (Philadelphia and New York 1915).

M. G. KAINS.

PLANTS, Fossil. See PALEOBOTANY.

PLANTS, Geographical Distribution. See PLANT GEOGRAPHY.

PLANTS, Hybrids in. See HYBRIDS IN PLANTS.

PLANTS, Lore of. Quite apart from all the fancies connected with flower language and symbolism (see FLOWERS, SYMBOLISM OF), there is an abundant stock of traditionary lore associated with all kinds of trees, plants and flowers. The study of this throws much light on many puzzling survivals in folk-lore, and some writers have shown its importance for part of the problem of primitive religion. Among Australians and red Indians the totem often takes the form of a plant or tree, for which the individual shows his reverence by refusing to gather or destroy them. The worship of trees is widely prevalent among savages everywhere, and there is ample evidence that it was an important element in the religion of all the families of the Aryan stock. Grimm thinks the oldest sanctuaries of the Germans were natural woods, and hints at a historical connection between the ancient sacred inviolate wood and the later royal forest.

The oak-worship of the ancient Druids, the sacred fig-tree of Romulus in the centre of Rome, the *Ficus religiosa* of India, and the sacred groves of the Semitic and pre-Semitic races still surviving at Carthage a century after Augustine, are ready examples of tree-worship from sufficiently wide centres of civilization. The primitive mind of the savage readily conceives of a tree as animated by a conscious soul cognate with his own, and he may regard the tree either as its permanent outward organism or merely as its characteristic dwelling-place. Hence trees have their place in fetishism, idolatry, and the upward development of religion. Buddhists do not include trees among sentient beings possessing mind, but recognize the existence of the genius of the tree, and Buddha himself was regarded as such no less than 43 times during his transmigrations. The reverence paid to the famous bo-tree shows how fundamental a fact is tree-worship, which undoubtedly formed a large part of the old Hindu religion amalgamated by the new philosophical faith.

But the sacred tree and grove are likewise to be found within the range of Semitic and Aryan influences. From all sides appears evidence at once of the great antiquity and uniformity of the worship of trees, whether for the services they render to man, for their venerable antiquity, their form, for particular qualities ascribed to them as containing the seeds of fire, for their situation, as on sombre and lonely mountain tops, or for their association with certain phenomena, as plagues and pestilences, or certain events in the history of the homestead. In the growth, life, decay and death of the plant the primitive man easily sees an analogue to his own life-history, and herein we may find the philosophy of the widespread rustic rites associated with marriage and with the birth of children. The custom of scattering flowers and the fruits of the field over the footsteps of a newly married pair conveys an obvious reference to the belief in the reproductive powers of vegetation. Primitive ideas of the fertilizing and fruit-bearing powers of nature led to the belief that each tree or plant possesses spiritual as well as physical life, being tenanted either by semi-divine spirits or by the ghosts of the dead, and a natural generalization of this notion made plants and trees collectively the abode of particular inhabitants — an example of animism developing into polytheism.

A forest-god has been deduced from a mere tree-soul, both alike regarded as powerful to produce rain or sunshine, to cause fruits to spring and cattle easily to bring forth their young. A still higher generalization gave a belief in a genius of plant-life or forest-life, or, higher still, a genius of growth or fertility in general. This universal genius of growth was symbolized by a bush or tree, brought in triumph from the forest, gaily decked, and solemnly planted near the homestead or in the village. In many cases the tree-spirit was regarded as detached from the tree and clothed in human form as a man or girl decked with flowers — the May-king, Queen of the May, the Old Woman or Corn-mother of German harvest-fields, the Jack-in-the-Green of young London sweeps, and the like. The existence of those corn spirits which especially haunted and protected the waving corn is dimly recognized in characteristic ceremonies of an English harvest-home, and in the French and German observance of the Harvest May, in which a branch or tree decked with ears of corn is carried home in the last wagon from the harvest-field and hung on the roof of the farmhouse till the next year.

Sympathetic affinities between plant and animal life strongly impress the primitive imagination and play an important part in many cosmogonies, as in the Iranian account of how the first human pair grew up as a single tree, the fingers or twigs of each one folded over the other's ears, till the time came when they were separated, and endowed with distinct human souls. Other mythical cosmogonic trees are the heavenly fig-tree of the Vedas, and the ash-tree Yggdrasil of Norse mythology. The belief that a child's rickets can be cured by passing him through a cleft ash-tree till lately lingered in corners of England, and stories of trees giving forth human groans and exuding human blood are common in folk-tales everywhere. Families, as well as individuals, have tutelary or guardian trees.

Even the Christmas-tree, which originally made its way into England and France principally through the influence of Prince Albert and the Duchess Helen of Orleans, is really a survival of an ancient German custom of heathen origin. Many plants have received a kind of religious consecration from the name of some saint whose festival fell on the day on which they were gathered. Christianity, like Buddhism, early showed a marvelous adaptability in the way in which it adopted popular rites of an earlier religion and rebaptized them as its own. Many remnants of primitive superstitions survive in the local English names of plants and flowers, chiefly in connection with the fairies, the devil, the Virgin and the Cross, and we have a great wealth of association from one cause or other between saints and flowers, as Saint Agnes with the Christmas rose, Saint Joseph of Arimathea with the Glastonbury thorn, Saint Patrick with the shamrock, the Virgin with the white lily, just as Thor had its oak-tree, Venus her myrtle, the Indians the lotus, and the Druids the mistletoe. Again, historical personages and families are frequently associated with particular flowers — it is enough merely to name the orange lily, the red and white roses, the fleur-de-lis, the planta genista, and the violet. Family and clan crests frequently take this form, as the fir, holly, juniper; also national badges, as the rose, thistle, shamrock.

More curious and interesting, though obscure, are the notions of magical properties connected as persistently with some plants as medicinal properties are with others. Most prominent in European folk-lore are the elder, the thorn, and the rowan or mountain ash; but strange properties are still ascribed to the rosemary, vervain, Saint-John's-wort, mandrake, asphodel, and to fern-seed; and many flowers lend themselves through some obscure inherent fitness to special methods of divination. The doctrine of signatures, so important in the history of medicine, opens up a special chapter of sympathetic magic, involving the belief that plants bore by nature marks indicating plainly for what diseases they were medicinally useful. The trees of Paradise, of Chaldæan and other cosmogonies, the oracular oaks of Dodona, those trees of healing spiritually allegorized in the Apocalypse, the trees of Liberty and the French Revolution, and the trees round which an Indian bride and bridegroom walk hand in hand point as unmistakably to a real sympathetic affinity between the human and the vegetable world as did the Dryads, Fauns and Satyrs of the ancient Hellenic mythology, with their analogues the elves and fairies of the woods, the transformation-myths, the Orpheus whose lyre laid its charm on beasts and trees alike, or the Pan at the report of whose death all nature mourned aloud. Consult Dyer, 'Folk-lore of Plants'; Frazer, 'Golden Bough.'

PLANTS, Malformations in. Malformations in plants are more or less conspicuous growths or deformities which do not occur in the normal life history of the plant but are caused by various agencies, such as insects and other animals, fungi and other plants, and sometimes by merely mechanical accidents, and sometimes by agencies which are entirely unknown.

Most of the conspicuous malformations caused by insects and by other plants are called galls (Fig. 1). The gall-flies (Cynipidæ), the gall-nats (Cecidomyiidæ), mites, caterpillars and the larvæ of the beetles are the most frequent causes of galls; but many are caused by fungi. In most cases the depositing of an egg by an insect is the stimulus which initiates the formation of abnormal tissues and outgrowths; but in many cases, the principal stimulus comes later, in the development of the larva from the egg. The nature of the stimulus still needs investigation, but it has some of the characteristics of fertilization; at least, there is a stimulus to growth and development. Whether there is any transmission of hereditary characters or not is a question; but it is an undeniable fact that certain insects produce certain galls with such distinct characters that analytical keys can be constructed for the identification of galls.

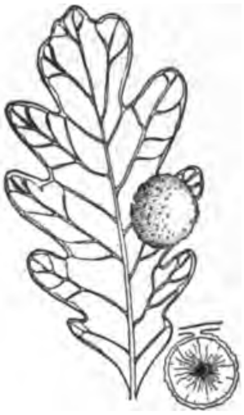

FIG. 1.— Gall on leaf of White Oak: a sectional view is shown below, at the right. The harder, inner part, suspended by strands, contains the grub.

Galls occur in every great group of plants, even in the algæ and fungi; they are not numerous in the Bryophytes, the liverworts being particularly free; in the Pteridophytes they are more numerous. In the Gymnosperms, there are many galls, some of them, like the «Witches Broom» and «Cedar Apples,» being very conspicuous. In the Angiosperms, especially in the Dicotyls, galls reach their maximum in display, distribution and variety. No less than 901 different kinds of galls are found in the Fagaceæ, the family which includes the beech, chestnut and oak, the latter having more kinds of galls than any other plant. The Compositæ (Sunflower Family) come next with 664, followed by the Salicaceæ (Willows and Poplars) with 573, the Rosaceæ (Rose family) with 500, the Leguminosæ (Peas, Beans, etc.) with 481, the Cruciferæ (Mustard, Radish, Turnips, etc.) with 256, the Labiatæ (Mint family) with 217 and various others ranging down to a single gall. Among the Monocotyls, the Gramineæ (Grasses) lead with 193, no other family having even as many as 50. Many families, both in Dicotyls and Monocotyls, are entirely free from galls.

A gall may consist of a single cell or of many cells which have been modified by the infection, producing distortions without adding to the number of cells; or the infection may stimulate cell division and growth, building up extensive new tissues with characteristic forms. In plants which are normally hairy, the hairs may be enlarged and modified in shape, but the infection often results in the formation of hairs on plants which are normally smooth, as in case of the common basswood. The leaves are quite smooth, but when infected, the epidermal cells grow out into long hairs (Fig. 2). In this connection it is of great interest to note that not only may structures, like the hairs, be produced in plants which are normally smooth, but it is claimed the structures called forth by the stimulus may resemble those of closely related species.

Entire leaves are often greatly reduced and distorted, their margins may be folded in and adjoining surfaces may grow together. Flower clusters are often modified and young vegetative shoots may be greatly reduced, so that the leaves become crowded and make the shoot look like a cone, as ofter seen in the willows. In some Composites, like the sunflower, the infection causes a distorted vegetative development to take the place of floral development and the head looks like a modified involucre.

Large swellings are often caused in the stems of herbaceous plants, the galls on stems of golden rod being familiar examples. The more or less spherical galls on rosebushes and on leaves and twigs of oaks are often highly colored. The large spherical gall, often an inch in diameter, found on oak leaves and twigs, is a good example of a very complicated gall (Fig. 1). At maturity, it is dry, papery and hollow, with slender strands suspending a hard portion within which is the insect.

Many malformations caused by plants come within the category of galls. Some of these take the form of conspicuous irregular distortions; while others are scarcely noticeable blisters or spots on leaves or stems, or may be merely internal malformations, not visible from the outside. Perhaps the most familiar gall of the irregular distortion type is the corn smut, caused by the fungus, *Ustilago Maydis*. On the young ear of corn this gall becomes as large as one's fist, and on the tassel the distorted portions may be as large as hickory nuts or walnuts. Similar galls, not so large, but caused by related fungi, are very numerous. The smut on wheat and oats and other cereals are only too well known examples. (Figs. 3 and 4).

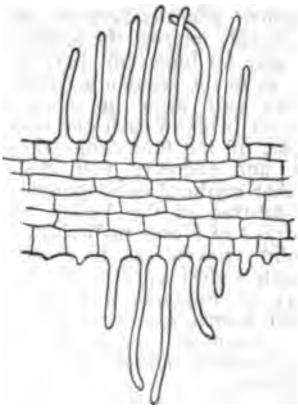

FIG. 2.— Filamentous gall on leaf of Basswood.

The «Club Root» of cabbage, cauliflower, turnip and other members of the Crucifer family is a large gall caused by *Plasmodiophora brassicæ*, one of the Myxomycetes (Fig. 5). The knotty swellings prevent the normal functioning of the root and thus stop the growth of the head and finally kill the plant. The spores of the fungus will live in the soil for years.

The «Black Knot» caused by the fungus, *Plowrightia morbosa,* is very destructive to cherry and plum trees. The infected twigs become swollen, often to several times their normal diameter, and the disease becomes so deep seated that the branches are killed. In 1906, «Black Knot» had become so destructive to cherry trees in North Carolina, that cherry-growing was practically abandoned in that State, and at one time this disease almost put an end to the cherry industry in Maine. Infected twigs should be pruned off in the autumn or early winter and destroyed.

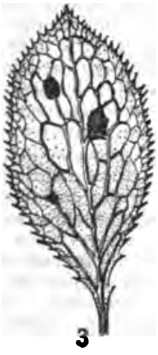

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Fig. 3. — Rust of wheat and oats; the æcidium, or cluster cup stage on leaf of Barberry. The rust appears as yellowish spots.

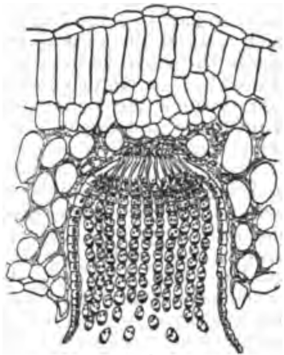

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Fig. 4. — A greatly magnified view of a section of one of the cluster cups on Barberry leaf.

The «Cedar Apples» of the Red Cedar, *Juniperus virginiana,* are interesting galls caused by the fungus, *Gymnosporangium.* The cedar twigs are infected in the autumn and the gelatinous, yellowish galls appear in the spring. They consist of great masses of teleutospores which promptly germinate putting out a short tube consisting of four cells, each of which produces a spore. These spores germinate on young quinces, june berries, hawthorns and apples, or on the young twigs of these trees, causing destructive malformations. Since the fungus cannot complete its peculiar life history without the cedar apple stage, the disease can be eradicated by destroying the junipers in the vicinity of the orchards.

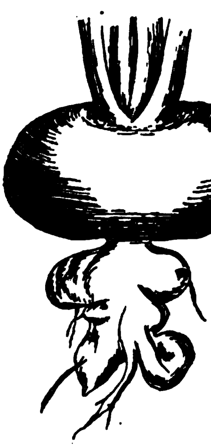

Fig. 5.— The " Club Root " gall on roots of a turnip.

The «White Rust» caused by the fungus, *Albugo candida,* is rather common on the «Shepherd's Purse,» *Capsella,* and upon various other members of the Mustard family. On the stems, leaves and flowers of *Capsella,* it forms blister-like white galls, which rupture the epidermis and scatter the asexual spores. It also develops a sexual stage, usually on the upper part of the stem or on the flowers, causing considerable distortion but not rupturing the tissues or causing any change in color. On the other hosts, the sexual stage may cause a distinct change in color.

One of the most familiar galls is seen in the «root tubercles» of the Leguminosæ (Pea family) caused by bacteria (*Rhizobium radicicola*). These swellings, or tubercles, enable the plant to make use of free nitrogen in the soil. Clover is abundantly supplied with these root tubercles which not only add to the vigor of the clover, but improve the soil.

A peculiar gall caused by «Bacterioids» associated with a blue green alga (*Anabaena*), is found on the rootlets of the cycads. The infection causes the rootlets to swell to several times their normal size and changes the direction of their growth, so that instead of growing down, they grow straight up and emerge above the surface in profusely branching coralloid masses.

One of the most remarkable and most thoroughly investigated of all galls is the «Crown Gall,» which has been called a plant cancer and is caused by *Bacterium tumifaciens.* It is very destructive to the apple, peach, plum, cherry, apricot, blackberry, grape, potato, tomato, tobacco, turnip and many other crops. It is particularly disastrous to young plants in the nursery. The bacteria have been isolated in many cases and from pure cultures obtained in this way many species have been inoculated and the characteristic galls have been induced, so that the relation between the bacteria and the galls has been established. The development of the disease closely parallels the progress of cancer in man and animals. In both cases, there is some stimulus to internal cell division. In case of the «Crown Gall,» that stimulus is a definite organism, but in man no definite organism has yet been discovered. The results of investigations upon the crown gall make it seem probable that some organism may yet be found to be the cause of human cancer.

Some malformations caused by large plants have been classed as galls. As the mistletoe grows into the branch of its host, the host is stimulated and grows up around the base of the parasite. When the parasite dies and falls off, the outgrowths of the host, with the characteristic markings left by the parasite, are called «Wooden Roses.»

There are many malformations in plants not caused by either insects, fungi or other plants One of the commonest of these malformations is known as *fasciation.* A familiar example is often found in the dandelion, where the flower scape, instead of presenting its usual tubular shape, becomes broad and ribbon-like. Many plants show deformities of this sort. Various malformations are found in flowers, the most common being those in which one floral organ takes the form of another or in which a floral organ takes the form of a leaf. In the doubling of roses and many other flowers, the stamens become petals, or rather, the embryonic growths which normally would have developed into stamens, develop into petals. Similarly, we sometimes find leaves where we should expect to find carpels, which form the ovary. Any of the floral parts, sepals, petals, stamens and carpels may be replaced by leaves, and this fact is cited as proof that they were all leaves originally and that they have been modified to their present form from which they occasionally revert to the ancestral leafy condition.

The leaves of ferns, especially in greenhouses, often become greatly modified. Plants of the «Boston Fern» type often have leaflets which branch repeatedly at the tips, so that the plant bears little resemblance to the type. *Pteris cretica,* which normally has entire leaflets, has given rise to varieties with leaflets profusely branched.

The navel orange is a very valuable malformation due to an excessive enlargement of the axis just below the portion which constitutes the fruit in seedy oranges. The «Navel» of the navel orange represents the whole orange of the normal type.

Most of the literature on malformations is found in works dealing with galls and with various plant diseases.

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PLANTS, Medicinal, plants of which some part is used in medicine or from which some preparation is extracted for similar purpose. To persons unacquainted with the nature of the various wild plants which surround them in farm and outdoor life, it comes as a great surprise to find that the world's supply of crude, botanical (vegetable) drugs are for the most part procured from the leaves, bark, seed, flowers, rhizome, etc., of these very plants, many of which are regarded as noxious weeds. The most valuable drug-plants which grow in America, from the point of view of the grower, are ginseng and golden seal (qq.v.), but there are all told more than 1,000 different plants which are indigenous or naturalized in the United States alone. Some of these are very valuable and have, since their medicinal properties were discovered, come into use in all parts of the world, others now collected in the United States have been brought here, and much, like the English sparrow, become in their propagation a nuisance and a pest to the farmer. The limitations of the present article preclude any extended discussion of the methods and habits of growth of the several plants, the methods of planting, cultivating, curing, preparation or extraction of the drugs, prices, etc. This information will be found, in the case of the more important plants, in the articles on these plants, v.g., Ginseng. It is intended here merely to set forth briefly those plants having a medicinal value, indicating the part or parts so used, and the general uses of each. As in the case of many native medicinal plants the early settlers in America learned of the virtues of Golden Seal (*Hydrastis canadensis*) through the Indians, who used the root as a medicine and the yellow juice as a stain for their faces and a dye for their clothing. Golden Seal is also known by different names in different localities, most of them bearing some reference to the characteristic yellow color of the root, such as yellow root, yellow puccoon, orange root, yellow paint, yellow Indian paint, golden root, Indian dye, curcuma, wild curcuma, wild tumeric, Indian tumeric, jaundice root and yellow eye, eyebalm, eye root and ground raspberry. The rhizome or rootstock and rootlets are the parts used in medicine. When dry the root measures from one to two inches in length and from one-eighth to one-third of an inch in diameter. The Indians regarded Golden Seal as a specific for sore and inflamed eyes and it was a very popular remedy with pioneers of Ohio and Kentucky for this affection, as also for sore mouth, the root being chewed for the relief of the last-named trouble. The juice is also used as a diuretic stimulant and escharotic, the powder for blistering and the infusion for the dropsy. It is useful in digestive disorders and in certain catarrhal affections of the mucous membranes. In 1860 the root was officially listed in the United States Pharmacopœia. The plant is native from southern New York to Minnesota and south to Georgia and Missouri. It is estimated that the annual consumption of Golden Seal root is from 200,000 to 300,000 pounds annually, about one-tenth of which is exported. Consult Bulletin edited by Alice Henkel and published by the Bureau of Plant Industry of the United States Department of Agriculture.

Black Cohosh (*Cimicifuga racemosa*), also known locally as black snakeroot, bugbane, bugwort, rattlesnake root, rattleroot, rattletop, richweed and squawroot. It grows in the shaded woodlands from Maine to Wisconsin and south to Georgia and west to Missouri. The Indians long regarded the root as a valuable medicinal plant, not only for the treatment of snake bites, but it was also a very popular remedy among their women, and it is to-day esteemed as an alterative, emmenagogue and sedative. It is officially listed in the United States Pharmacopeia.

Blue Cohosh (*Caulophyllum thalictroides*), also known locally as papoose root, blueberry root, blue ginseng, yellow ginseng. The dried root is the part used in medicine as a demulcent, antispasmodic, emmenagogue and diuretic. Snakeroot (*Asarum canadensis*), also called wild ginger, Indian ginger, Vermont snakeroot, heart-snakeroot, southern snakeroot, colt's foot, broadleaved asarabacca, colic root, etc. The root is used as an aromatic, diaphoretic and carminative. Serpentaria, also known locally as snakeweed, pelican-flower, sangrel, sangreeroot, etc., grows in rich woods from Connecticut to Michigan and certain varieties occur in the southwestern States. The roots are used for their stimulant, tonic and diaphoretic properties. It is officially listed in the United States Pharmacopeia. May-apple (*Podophyllum peltatum*), also locally named mandrake, wild lemon, ground-lemon, hog-apple, raccoonberry, duck's foot, umbrella-plant, vegetable calomel, etc. It grows all over the eastern half of North America. The root is used as an active cathartic and is official in the United States Pharmacopeia. Pokeweed (*Phytolacca decandra*), also commonly called poke, pigeon-berry, garget, scoke, pocan, coakum, inkberry, American nightshade, cancer-jalap, redweed, etc., is found in rich soils along fence rows and on unimproved land from Maine to Minnesota and south to Texas. The root is used for its alterative properties in treating various diseases of the skin and blood, and in certain cases in relieving pain and allaying inflammation. It also acts upon the bowels and causes vomiting. The matured berries are also used in medicine. Seneca snakeroot (*Polygala senega*) or mountain flax, the root, once used by the Indians as a cure for snakebite, is now employed as an expectorant, emetic and diuretic. Lady's Slipper (*Cyripedium hirsutum Mill*), or moccasin-flower, nerve-root, male nervine, umbril root, etc., rootstock and roots are used in medicine as a nerve tonic and an antispasmodic, also for the same purposes as valerian. Bethroot (*Trillium erectum L.*), birthroot, bathwort red wakerobin, bumblebee-root, dishcloth, Indian shamrock, wood-lily, etc. Root used in medicine as an astringent, tonic, alterative and expectorant. Culver's Root (*Leptandra virginica*) or blackroot, speedwell, tall veronica, wholywort; rootstock and roots used as an alterative, cathartic and in disorders of the liver. Stone root (*Collinsonia canadensis*), or knobroot, horsebalm, richweed, ox-balm, citronella; root used for its tonic, astringent, diuretic and diaphoretic properties. Leaves are also used as an application to bruises. Crawley-Root (*Corallorhiza odontorhiza*) or coral root, dragon's claw, chicken toe, fever root; root used to promote perspiration and also as a sedative and in fever. Male fern (*Aspidium*) or sweet brake, basket-fern, etc.; root used as a remedy for worms. Care must be taken to avoid overdoses which are highly dangerous. Goldthread (*Coptis trifolia*) or cankerroot, mouthroot, etc.; root used as a remedy for ulcerated and sore mouth; also as a wash or gargle for similar affections and as a bitter tonic. Twinleaf (*Jeffersonia diphylla*) or rheumatism root, helmet pod, ground-squirrel pea, etc.; rootstock used as a diuretic, alterative, antispasmodic, and a stimulating diaphoretic. Large doses are emetic. Canada moonseed (*Menispermum canadense*), or yellow sarsaparilla, vine-maple, etc.; both roots and rootstock are used in medicine as a tonic, alterative, and diuretic. Wild turnip (*Arum triphyllum*), or wild pepper, devil's ear, starchwort, priest's pintle, etc.; the partially dried corn is used as a stimulant, diaphoretic, expectorant and irritant. Black Indian hemp (*Apocynum cannabinum*), bowman's root, wild cotton, etc.; root has emetic cathartic, diaphoretic, expectorant and diuretic properties, and is much used in dropsical affections. Chamælirium or Helonias (*C. luteum*), or unicorn root, drooping starwort, devil's bit, etc.; of especial use in derangements of women. Wild Yam (*Dioscorea villosa*), or colic root, devil's bones; root is said to possess expectorant properties and to promote perspiration, and in large doses providing emetic. It is sometimes used in bilious colic. Skunk-cabbage (*Dracontium fœtidum*), or polecatweed, collard, stinking poke, etc.; rootstock is used in affections of the respiratory organs, in nervous disorders, rheumatism and dropsical complaints. American Hellebore (*Veratrum viride*), or bear-corn, bug-bane, earth-gall, itchweed, etc.; it is an acrid narcotic poison, and has emetic, diaphoretic and sedative properties. Other medicinal plants with their specific uses in medicine are: Water-eryngo (diuretic, expectorant); yellow jasmine or jessamine (powerful effect on nervous system); sweet flag (aromatic stimulant and tonic in feeble digestion; dried root chewed for dyspepsia); blue flag (alterative, diuretic and purgative); cranes-bill (tonic and astringent); dandelion (tonic in diseases of the liver and in dyspepsia); soapwort (tonic, alterative, diaphoretic); burdock (alterative in blood and skin diseases); yellow dock (purifier of blood and in the treatment of skin diseases); stillingia, or queen's root, nettle-potato, etc. (alterative); American colombo, or yellow gentian, ground century, etc. (simple tonic, emetic and cathartic); couch-grass, quitch-grass, etc. (fluid extract used in affections of the kidney and bladder); echinacea, or coneflower, niggerhead (alterative and to promote perspiration); aletris, or stargrass, starwort, aloe-root, huskwort, etc. (of value in digestive affections); wild indigo, or yellow broom, shoofly, etc. (emetic and cathartic in large doses; stimulant, astringent and antiseptic; and as a local application to sores, ulcers, etc.); pleurisy-root (used in disordered digestion and in affections of the lungs to promote expectoration and induce easier breathing); blood root, coon root, yellow puccoon, tetterwort, tumeric, etc. (tonic, alterative, emetic and stimulant); pinkroot, or starbloom, wormweed (principal use is as an anthelmintic); Indian physic or false ipecac (emetic); wild sarsaparilla, shotbush, wild licorice (alterative, stimulant and diaphoretic); comfrey, or bruisewort, gumplant, slippery-root (used in coughs and diarrheal complaints; action is slightly astringent and demulcent); elecampane, or horseheal, elfwort, velvet-dock, wild sunflower (used in affections of the respiratory organs, in digestive and liver disorders, catarrhal discharges and skin diseases); queen of the meadow, or boneset, motherwort, quillwort, etc. (astringent and diuretic); hydrangea, or seven-barks (as a diuretic and in calculous complaints); Oregon grape, or holly-leaf barberry (tonic and blood purifier, berries in preserves and cooling drinks). Ginseng (roots exported to China, where they are reported to be used as an almost universal remedy. Odd-shaped roots are said to be especially prized as talismans. Many other plants are used in limited quantities, among which may be noted birch bark, blackberry, catnip, chicory, corn ergot or smut, geranium, hemlock, huckleberry, pennyroyal, peppermint, sheep laurel, tag alder, water pepper, wintergreen, witchhazel, etc.

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PLANTS, Migration of. Plants need a constant change of situation because they may exhaust the amount of the special food of each species in the soil; or impart to that soil injurious elements; or for the sake of increased vigor. They accomplish the needed change by many methods. Very low forms, such as the molds, spread by a creeping action; some higher plants are torn up by the roots and rolled long distances, to survive and renew their fixture and growth when favorable conditions are reached. Those that have "runners," like the strawberry, reach out, take root at a distance and so advance by long steps, as it were; while the grasses, ferns and others make similar progress by means of underground root-stems. Dissemination is accomplished more generally, however, by means of fruit (seeds). In many cases the seed-pods are so strained by ripening that at last they burst, hurling the seeds to a considerable distance, or the pods open and the seeds are tossed out by some agitation of the plant, usually with elastic force. No sort of this machinery, however, advances the plant-species more than a few feet; and far more effective is dispersal by wind and water. To this end seeds of a large variety of trees and herbs are provided with wings, like those of the maple and tulip-tree, or with long feathery attachments, like cotton and dandelion, which serve as parachutes to sustain them in the air while wafted away to new habitats. These windblown seeds are always minute and oily, the latter feature giving them the necessary lightness of weight. Floating is a means of dispersal important not only to aquatic plants, but to others. Many river and pond-plants move bodily and are carried here and there by currents; and floods often transport living land-plants to new regions. Some send abroad regenerative parts, as buds; or, in more cases, seeds in capsules or little bladders, or air-tight pods. The wide distribution of the cocoanut palms throughout the tropics is due to the ability of the tight nut to float long distances. Mangrove seeds are especially fitted to do so; and that a great many other land-growing trees and plants can make long voyages, as seeds, is shown by the vegetation clothing remote islands and the way in which island floras are related to prevailing oceanic currents. That animals assist plants to migrate is well known. Many seeds are provided with hooks that catch in hair and wool and are carried onward by passing animals. Birds and mammals eat fruit and drop the uninjured seeds perhaps miles away. The planting of nuts by squirrels, jays and so forth, is useful in this direction. Finally, man has been distributing plants by his operations ever since he began to move about, by the use of fruit and seeds for food, by passing them on for new orchards and grainfields from country to country; and also by the accidental carriage of them in his ships and otherwise. Every country now has many introduced species. See PLANT GEOGRAPHY.

PLANTS, Morphological Evolution of. The distinction of all living things into plants and animals seems on first thought to be an easy one to make. Animals walk or fly or swim, have mouths by which they eat food and stomachs in which to digest it; they have eyes with which to see, ears to hear, etc.; while plants are firmly fixed by their roots, have no power of motion, take their food from the air and dissolved in water from the soil and have in the common view no power of perception of light, sound, etc. The foregoing distinctions are true if we confine our attention solely to the higher groups of plants and animals. But when we follow downward from the more complex to the simpler plants and animals we find that we are converging more and more until we reach some groups of organisms which have been claimed by both botanists and zoologists. It is impossible to deny that some of these have almost equal right in either kingdom, so that any line that may be drawn to separate animals and plants must be arbitrary. On the other hand many forms that were once considered to be plants are certainly animals, e.g., sponges, corals (*Bryozoans*), while such a group as the slime molds (*Myxomycetea or Mycetozoa*), still regarded as belonging to the plants by most botanists, in reality seems to show phylogenetic kinship only with the animals and so ought to be placed there. There still remain, however, certain groups which cannot be looked upon as other than transitions from animals to plants or plants to animals. It is for these transitional groups that it is especially difficult or absolutely impossible to draw a natural line of separation between the two kingdoms. The organisms in question include the *Flagellata* (in the wider sense of the term) and the related *Volvocales* (often included in the *Flagelata*) and the *Peridiniales* (or *Dinoflagelata*). These are in part colorless organisms, but many of them are green and contain chlorophyll by means of which they manufacture food in the same manner as undoubted plants. They are, however, motile during their chief vegetative period, non-motile and encysted only during rest periods. In the latter stages they are very similar to the ordinary vegetative stage of many undoubted plants belonging to the order *Chlorococcales*, in which during reproduction motile, naked cells are formed that are scarcely distinguishable from the vegetative stages of the organisms under question. Any line drawn will be arbitrary: perhaps the most logical procedure, then, is to consider as animals those forms in which the motile, usually naked stage is predominant, with the non-motile, encysted stage serving merely to tide the organisms over until favorable conditions again occur, while those forms are to be called plants in which the ordinary vegetative stage is non-motile and only the reproductive stages motile. The foregoing distinctions must, of course, be understood to apply only to those debatable groups which have most of their other characters in common. The sponges are motile only during their reproductive stages, but in their other characters they are animal so that this rule would not apply, while the motile diatoms like *Navicula* are so plantlike in other features that they would also not be affected.

With the forgoing in view we may consider the stages of evolution in plants. In so doing it must be remembered that the first plants came into existence eons ago and that it is impossible to be certain just what they looked like or what was the early course of their evolution. Judging by the simplest plants now known these first plants must have been naked, without any hard parts to be preserved as fossils. Hence the earlier rocks carry very few remains that can be with certainty ascribed to the simpler plants, it being only in the most recent rocks that some of the softer aquatic forms are recognizable, although it seems certain that for ages the only plants in existence were water plants. Accordingly we must have recourse to the now existing forms of these simpler plants, making the perhaps not unwarranted assumption that they represent, as it were, stragglers along the line of evolutionary advance whose progress has been slow, so that although they are descendants of those primitive plants of ages ago yet they have changed but little in this long period of time. By this method the main lines of evolution may perhaps be indicated with a fair probability of correctness, but it will perhaps always be impossible to clear up the details to such a degree as has been done in the study of the ancestry of the horse and other animals which having hard skeletons have left permanent records in the rocks.

The simplest plants now known are some of the bacteria and the one-celled blue-green algæ (*Chroococcus*, etc.). There is no serious doubt that the bacteria and the blue-green algæ are closely related; which are the oldest, however, is a question that offers many difficulties and that seems beyond our present powers of solution. Most bacteria are unable to grow without the presence of some organic matter while the chlorophyll-containing algæ are independent in that they can manufacture their own organic matter from inorganic substances. Thus *a priori* they would seem to be more primitive. Yet, on the other hand, there are a few bacteria which if supplied with ammonia or nitrites are able to make use of CO_2 without the need of light or of chlorophyll and thus build up their necessary organic compounds. It is here assumed, however, that the bacteria are not primitive but derived from the blue-green algæ.

These most primitive plants that we know, e.g., *Chroococcus*, consist of minute balls of protoplasm colored bluish green and enclosed in a thin wall made up in part of chitin. The central, uncolored part of the protoplasm probably functions as a nucleus or directive centre for the plant, but is not set off distinctly from the rest of the cell as is the case in the higher plants. Neither is the coloring matter located in definite organs of the cell, the chloroplasts, but merely scattered throughout the outer part of the protoplasm. Reproduction, also, is simple, consisting of the division of the cell into two cells which soon separate. The next step in evolution seems to have been that of the adherence of these cells for some time after division, resulting in the formation of irregular colonies. As the successive directions of division became more and more fixed these colonies came to have more and more definite shape, square plates, cubes, hollow spheres, etc., the furthest advance seemingly having occurred in the formation of filamentous colonies. In these the successive planes of division are all in the same direction. In *Oscillatoria* and its near relatives the cells of the filament are all alike, but in the somewhat higher forms such as *Nostoc*, certain cells are enlarged (heterocysts). A further type of cell differentiation is seen in *Rivularia* and its relatives in which the basal cell is a heterocyst and attached to some object, the next cells being large, those further out gradually diminishing in size until the ultimate cells are very long and slender or even pointed.

The bacteria are considered as an offshoot from plants related to *Oscillatoria* (e.g. *Phormidium*), the chief difference between such blue-green algæ and the higher bacteria such as *Beggiatoa* lying in the presence of the coloring matter in the former and its absence in the latter. The mode of growth and of reproduction are the same. From *Beggiatoa* the gradation is gradual throughout the filamentous bacteria and down to the one-celled forms that constitute the commonest forms of bacteria. Yet it is not certain that this line is continuous, for flagella, which are apparently lacking in the blue-green algæ and *Beggiatoa* are present in many of the one-celled bacteria. Possibly this indicates an origin of the latter independent of that of the filamentous bacteria.

All of the foregoing forms are placed in the Phylum *Myxophyceæ*. There remains a small group of plants placed by some botanists in this and by others in other phyla that are possibly a transition to the next phylum. These plants (*Glaucocystis*, for example) are blue-green, like the others, and multiply by division of the cells, but differ in the possession of a definite nucleus cut off from the remainder of the cell by a nuclear membrane, and in the restriction of the coloring matter to definite organs, the chloroplasts.

In the next phylum, Chlorophyceæ, the coloring matter is bright green, instead of blue-green, and is mostly, if not always, confined to definite chloroplasts, usually large and few in number in the cell. The nucleus, moreover, possess a definite membrane and is well organized. The cell wall is composed of cellulose or carbohydrates of kindred nature. Multiplication by simple division of the cell is not the sole method of reproduction except in a few forms, such as Protococcus. On the contrary we find that two great advances have taken place in the reproductive methods in this phylum. The first is the production of zoospores. The contents of a vegetative cell, or, in a few of the more specialized forms, of a special cell, divide up within the wall into a number of naked cells provided with long flagella, or swimming organs, by means of which after emerging from an opening in the cell wall the zoospores (as these naked swimming cells are called) swim around. After a while they settle down, form a cell wall and start the new plant. The second great advance is the introduction of sexual reproduction. This seems to have been at first a modification of the foregoing method, for in some of the more primitive forms of this phylum, e.g., *Ulothrix*, certain swimming cells act merely as zoospores under some external conditions while under other conditions the naked cells fuse by pairs, not merely the cytoplasm but also the two nuclei undergoing fusion. In the more highly developed members of this phylum we find the two functions entirely separated so that the cells that function sexually are entirely distinct from those that act as zoospores for the asexual reproduction of the plant. In this first appearance of sexuality it is noteworthy that sexual reproduction occurs in plants (and the same is true for animals) before there is any distinction of sex.

In this phylum as in the Phylum *Myxophyceæ* we find two tendencies exhibiting themselves in the vegetative structure, viz., the formation of plants consisting of single cells or regular or irregular colonies of cells (Class *Protococcoideæ*) and that of plants consisting of simple or branched filaments or rarely sheets or tubes (Class *Confervoideæ*). In the more highly developed members of the latter class we find that the sexual reproduction has undergone a further evolution. Instead of producing sexual cells that are all alike these plants produce two kinds of gametes, smaller, very actively motile sperms, usually arising in large numbers, and larger, less numerous, sluggish eggs. This is the beginning of the differentiation of sex. The further development along this line of evolution led to the complete loss of motility by these eggs and their retention, for further protection, within the walls of the mother cell (the oogone) where the sperm seeks them out and fertilizes them, entering through some sort of an opening in the cell wall. The height of evolution in this direction in this phylum is reached in *Coleochæte,* in which the fertilized egg becomes surrounded by an investing layer of protective filaments which makes its safety doubly sure.

Closely allied to the one-celled green slimes (Class *Protococcoideæ*) are those organisms mentioned before, whose assignment to the animal kingdom or vegetable kingdom is a matter of rather arbitrary choice. A form like *Chlamydomonas* is to all intents and purposes a permanently motile zoopore which loses its flagella and becomes invested with a firm cell wall only to enable it to survive unfavorable conditions. In mode of reproduction and in structure it clearly approaches on the one hand such an undoubted plant as *Chlorococcum* and on the other certain of the *Flagellata* whose kinship to the rest of the animal kingdom is incontestible.

From the simpler, filamentous *Chlorophyceæ* appear to have arisen the conjugate algæ phylum (*Zygophyceæ*), whose more primitive forms are filaments made up of uninucleate cells with green chloroplasts. The power of producing motile zoospores has become lost and sexual reproduction takes place by the union of the non-flagellate protoplasmic contents of adjacent cells, usually of neighboring filaments, rarely within the same filament. By a further differentiation of the cells and organization of the cell wall into two distinct pieces we find the desmids (Order *Desmidiales*) arising. In this order the filamentous condition of the more primitive forms soon becomes lost as the filaments become more and more constricted at the joints, until in the highest genera the filaments are very few celled or even more often reduced to single cells. The diatoms (Class *Bacillarioideæ*) with their silicified walls and their brown-colored chloroplasts appear to be related to the desmids, to the filamentous forms of which they show the nearest resemblance, especially if the filamentous diatoms are selected in making the comparison. In parallel development we find the gradual shortening of the cells of the filament in each order and the eventual breaking up of the filaments into one-celled forms, exactly as happened in the desmids.

Again going back to the simpler filamentous *Chlorophyceæ* we find another group (phylum *Siphonophyceæ*) arising. The evolutionary tendency in this case has been along the line of cœnocyte development, the rather short, uninucleate cells of the *Chlorophyceæ* giving way to longer, multinucleate cœnocytes with septa at occasional intervals (*Cladophora*) and finally to tubular cœnocytes almost completely lacking cross walls. In the simpler forms the asexual reproduction by zoospores and sexual reproduction by the union of equal motile gametes resembles very closely that of the simpler *Chlorophyceæ,* but, as in that phylum, the higher groups show, first inequality of gametes, both retaining motility, and finally the complete loss of motility on the part of the female gamete which is retained within its mother cell wall, as in *Vaucheria.* From plants clearly very close to this last have arisen a large number of genera and species of chlorophyll-less forms comprising the class *Phycomyceteæ.* Vegetatively these resemble *Vaucheria* and its nearest relatives in consisting of branching, non-septate, tubular cœnocytes, the chief point of difference being the lack of chlorophyll. This necessitates a different mode of life, either saprophytic, i.e., feeding on dead organic matter, or parasitic upon animals or more often plants. As to asexual reproduction that, in the lower *Phycomyceteæ* is by means of zoospores while sexual reproduction is by means of motile sperms which seek out the non-motile egg within its oogone. In most members of this class, however, evolution has gone a step further and made fertilization less a matter of chance by developing a tube which leads from the antherid into the oogone, so that there is no opportunity for the sperm or at least its nucleus to fail to reach the egg. These colorless plants are aquatic, like their green ancestral forms, in the more primitive groups (*Saprolegniales*), but in the downy mildews (*Peronosporales*) we find that they have emerged and become parasitic in higher plants. Having ceased to be aquatic they did not at once cease to produce zoospores in the course of their life cycles. However, the zoosporangia became reduced in size and instead of setting the zoospores free while still attached to the plant, the zoosporangia themselves are set free to be scattered by the wind, producing the zoospores only when they fall into a drop of water. In two genera of the group there is one step further that has been taken in that the zoosporangia fail to produce zoospores at all and germinate directly.

In the black molds (*Mucorales*) the evolution proceeded differently. Evidently this group also arose from the aquatic *Saprolegniales,* but as the fungi emerged from the water and became terrestrial the zoosporangia became larger instead of smaller and did not set their contents free as naked zoospores but permitted these to become encysted before they were set free to be scattered by the wind. In this group a few genera show a rapid reduction of size of these large sporangia until some forms are known in which, as in the preceding group, the sporangium is reduced to a small, wind-distributed body or conidium.

The *Chlorophyceæ* appear to have been a very prolific group for the production of other phyla. So in still another direction we find arising the brown algæ (*Phylum Phæophyceæ*), whose primitive filamentous forms reproduce asexually by zoospores and sexually by the union of equal motile gametes. In this phylum the vegetative structure has undergone the greatest evolutionary advance among all the lower plants. From simple filaments of cells to the massive kelps or complicated rockweeds or sargassums there is almost an unbroken series. Except for some of the largest trees the biggest plants in the world are the giant kelps (*Nereocystis*) of the north Pacific Ocean, some of which attain a length of several hundred feet with stems several inches in thickness. Along with this external differentiation we find tissue differentiations to a higher degree than in any other plants outside of the so-called "vascular" plants, which are very much further developed evolutionally. On the other hand the reproductive processes are but little modified. Asexual reproduction by means of zoospores persists in most of the forms, although lacking in some of the higher members of the phylum. Sexual reproduction consists of the union of equal motile gametes in the lower forms, of unequal motile gametes in those a little further advanced, and in the union of motile sperms of small size with large, non-motile eggs in the highest forms. In all cases the union occurs outside of the parent plant and the product of the union is a simple cell which by its division produces the new plant.

The great phylum of the red seaweeds (*Rhodophyceæ*) probably also had its roots in the *Chlorophyceæ*, but so many intermediate forms have been lost that it is difficult to imagine just how to picture the steps along which the evolution progressed. The simplest red seaweeds consist of unbranched or branched filaments of uninucleate cells, with their chloroplasts stained red or violet. Motile reproductive cells are totally lacking in the group, barring a possible amœboid motion observed in a few cases. Asexual reproduction consists of the production of non-ciliate cells, either singly or in fours (monospores and tetraspores, respectively), these escaping from their walls as naked protoplasts which are carried about by the water currents. Sexually, an egg, enclosed in an oogone, is fertilized by a naked-non-motile sperm which is carried by the currents and which clings to a projection of the oogone, the trichogyne. The sperm nucleus enters this projection and passes downward to the egg nucleus with which it unites. Now, unlike the forms hitherto under discussion, the fertilized egg undergoes rapid nuclear division and ultimately branches out into several or many filaments which terminate in the ultimate reproductive cells, the carpospores. Thus one sexual union results in the production of numerous reproductive cells instead of one. In the higher red seaweeds the carpospores give rise to plants which produce only the asexual tetraspores, while the plants arising from these tetraspores are, in turn, the sexual plants, thus introducing a new feature, the "Alternation of Generations" (q.v.). It is worthy of note that this feature appears to have arisen at various points in the vegetable kingdom independently. Aside from this complexity of reproductive processes the red seaweeds show all gradations within the group from simple filaments to very complex, massive bodies. Like the brown seaweeds they are prevailingly marine.

The red seaweeds are of interest, because from them seems to have arisen the great group of the higher fungi phylum (*Carpomyceteæ*) just as the lower fungi (*Phycomyceteæ*) arose within another phylum (the *Siphonophyceæ*). The fungi in question are filamentous and largely terrestrial, often parasitic upon plants or even animals. They lack chlorophyll, but in many ways show structural characters found also in the *Rhodophyceæ*. Asexual reproduction is by the production of non-motile conidia. The more primitive forms have a form of sexual reproduction that resembles greatly the process in the red seaweeds, viz., the union of a non-motile, water-borne sperm with an extension of the oogone, the result of the union being the development of an extensive mass of threads which terminate in the reproductive cells. These terminal reproductive cells are different in the three great classes of this phylum, being an ascus, containing usually eight spores, in the *Ascomyceteæ*, a basidium, producing externally usually four spores, in the *Basidiomyceteæ*, and a teliospore, producing a usually four-celled promycelium, which gives rise to four spores, in the *Teliosporeæ*. In this phylum we find that the sexual process has undergone several modifications as we pass from the more primitive to the more highly-developed groups. Thus the formation of separate sperm cells is omitted and the antherid and oogone (or its extension, the trichogyne) come in immediate contact. Finally antherids seem to be wholly omitted, the sexual process in such plants consisting in the union of what were potentially egg nuclei or their derivatives. In many fungi even the oogones fail to be produced, the nuclei that eventually unite being apparently of vegetative origin. Throughout the phylum the vegetative structure maintains its simplicity, consisting essentially of a more or less loose weft of branching, septate threads. It is the reproductive structures that show the greatest differentiation. Thus, one finds in this group such varied structures as the cup-like apothecia of the cup fungi, the globose, subterranean fruit of the truffle, the umbrella-formed mushroom, the bracket-like pore fungus, etc.

One of the most significant steps in the evolution of plants resulted in the development of the liverworts and mosses phylum (*Bryophyta*). This is the first group of chlorophyll-bearing plants to become terrestrial, although even in the first phylum (the *Myxophyceæ*) a few forms crept out on land to inhabit damp places. The plant body is mostly more compact than in the more or less filamentous *Chlorophyceæ*, which were probably the ancestors of this group. They are attached to the soil by rhizoids which serve not only to hold the plant in place but also to absorb water and pass it on to the plant. Their aquatic ancestry is still shown by the production of motile sperms which are dependent upon the presence of water at the proper time to enable them to swim to the egg. Another forward step is seen in the fact that the eggs are surrounded before fertilization by a protective layer of cells, forming a flask-shaped structure, the archegone. Unlike the lower *Chlorophyceæ*, the fertilized egg in this phylum does not become a thick-walled oospore but divides rapidly, forming a complex structure, rooted in the parent plant from which it draws a large part of its food, that produces internally the ultimate reproductive spores. The plant body likewise shows evolutionary development from a flat thallus in the lower liverworts, becoming lobed in those higher in the scale, and finally reaching the leafy-stemmed mosses.

In the next step, which probably took place rather rapidly, the relative importance of the sexual stage (*gametophyte*) and of the spore-bearing stage (*sporophyte*) has been reversed. As in the *Bryophyta*, the sporophyte starts as a single fertilized egg cell within an archegone. This egg divides repeatedly to form a many-celled structure which is at first enclosed within and dependent upon the gametophyte. Soon, however, it acquires its own roots and leaves and quickly becomes entirely independent of the gametophyte, which dies, leaving the sporophyte as the long-lived stage. This is the step of evolution that has been reached by three phyla, *Pteridophyta*, *Calamophyta* and *Lepidophyta*. These differ markedly from one another in the structure of the stem, leaves and spore-bearing organs, but the fundamental life history is the same, at least in the lower representatives of each group. By an apparently parallel development each of the three groups has taken a further but similar step, in that the spores produced are of two kinds, which produce respectively male or female gametophytes. These sexual plants are much smaller in size and depend for their food largely upon the food stored up in the spores themselves, instead of manufacturing it in large amounts, as in the mosses and liverworts or the lower members of these same phyla. This line of evolution is carried one step further in the phylum *Cycadophyta* (sago palms and their relatives), where the spores that produce the female sexual plants are permanently retained within the parent plant, undergoing their development there, including the formation of egg, fertilization of the latter and the beginning of the development of the new sporophyte generation. The resulting structure, consisting of the spore-containing organ (the sporangium), containing the remains of the female gametophyte, which in its turn contains the new sporophyte generation, is what is called a seed. In this phylum the aquatic ancestry is still revealed in the production by the much reduced male gametophyte of motile sperms which accomplish the fertilization of the eggs.

The last developed phyla in the vegetable kingdom retain the chief characters of the last-mentioned phylum. In them, however, the sperms are no longer provided with cilia or flagella by means of which they swim a short distance from the ruptured tip of the male gametophyte to the archegones containing the eggs. The male gametophytes themselves grow as long tubes down through the intervening tissues and spaces directly to the egg, only there rupturing to permit the sperm to accomplish its function. In one of these phyla (*Strobilophyta*, the conifers) the reproductive structures are chiefly arranged in cones with the seeds produced on their open surfaces. The highest development is found in the other phylum (*Anthophyta*, the flowering plants), where the seeds are enlosed within special structures, the pistils, thus attaining a maximum of protection. Vegetatively it is noteworthy that the sporophyte, which from the *Pteridophyta* (ferns) onward is the long-lived structure, becomes more and more complex in its external and internal structure, thus reaching its culmination in the *Anthophyta*, whose tissues as well as general structure are differentiated further than in any other group of plants. Within this group the plants vary from the minute duckweeds, only a few millimeters in dimensions, to the tall eucalyptus trees, towering 400 feet into the air, from annuals that live but a few short weeks and then lie dormant as seeds until favorable conditions again appear, to trees that may live for many centuries, from submerged aquatic inhabitants of rapidly-flowing streams to the spiny, leafless cacti of the deserts. And yet throughout this group the one structure, the flower, holds them all together in a common bond of kinship, and through this structure we can trace backward the steps of evolution until we again find the minute microscopic sexless plants that seem to represent most nearly the first plants that arose, eons ago, in the water or mud of the primeval sea.

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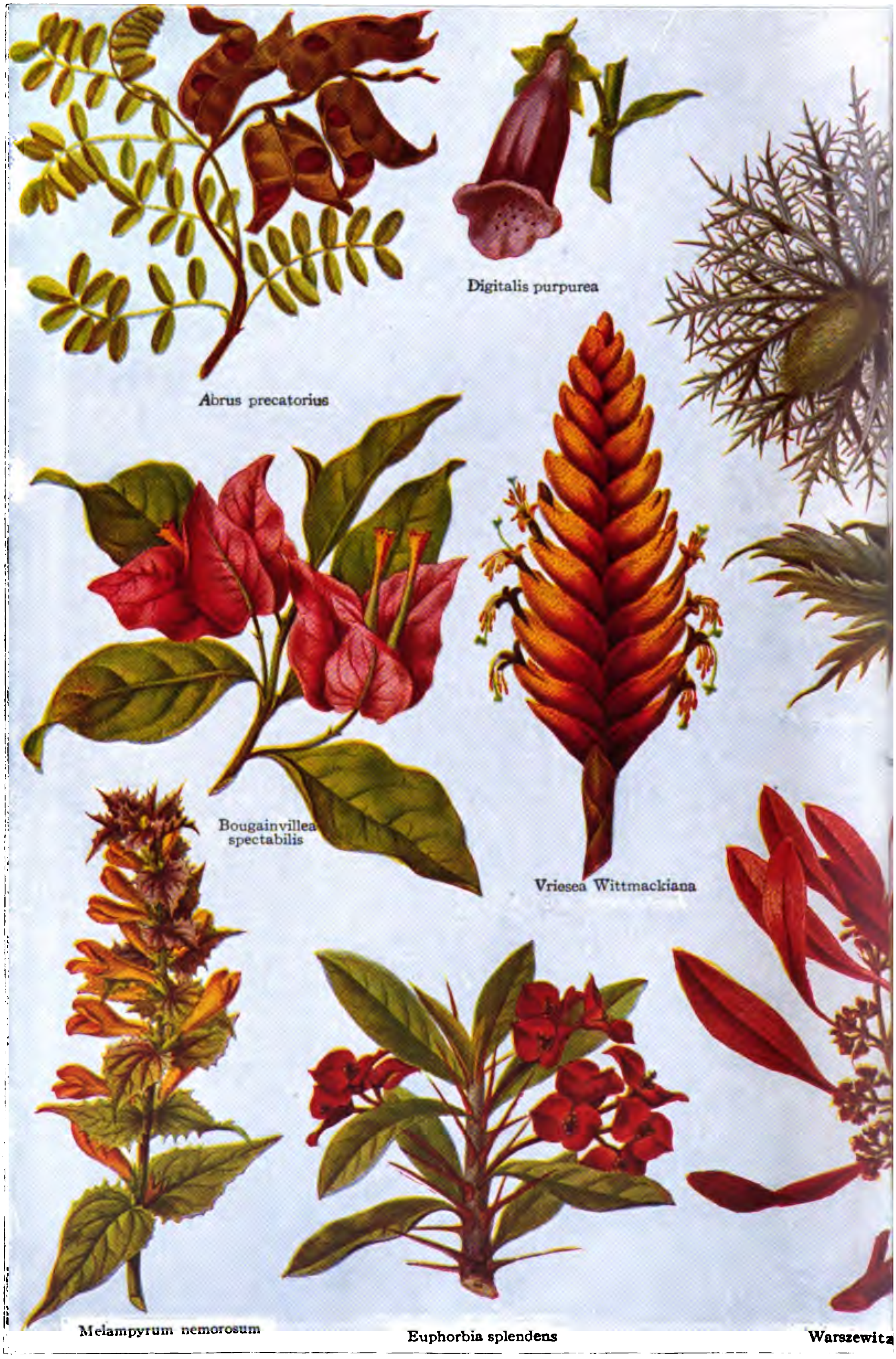
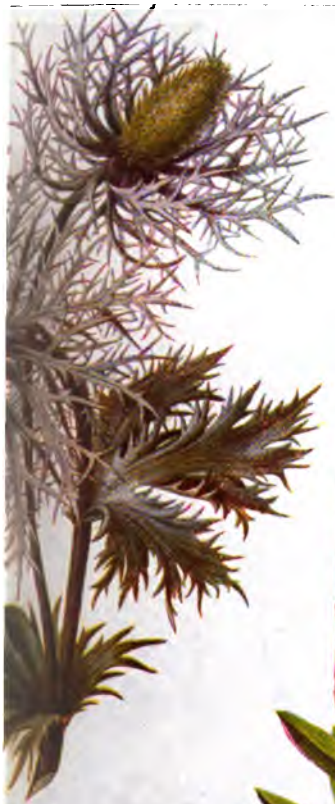
PLANTS, Ornamental. The climate and soil of North America vary so tremendously that only by a close study of local florists' catalogues, and the reports of State experiment stations, can the ornamental plants suitable for any given locality be determined. A hint of the trees, shrubs, climbers, aquatics and lesser herbaceous plants, of the perennial type, most frequently set out, is given below.

Rapidly-growing trees, particularly for treeless regions, are the cottonwoods (*Populus*) common along mid-western water courses; the silver maple (*Acer*) and the white willow (*Salix*) for moist soils: white and Scotch pines (*Pinus*) for sandy ones: white and Norway spruces (*Picea*); green ashes (*Fraxinus*); osage orange (*Toxylon*); European larch (*Larix*); black locust (*Robinia*); hardy catalpa (*Catalpa*) and Russian mulberry (*Morus*) are recommended for planting, serving as windbreaks, as shade trees and as material for fence posts and fuel.

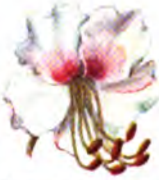
For street planting in city and village, certain trees have been found more or less resistant to the deleterious effects of urban existence. The most important of these are the plane-tree of Europe (*Platanus*) readily identified in winter by its long-hanging balls of fruit; the trim maples (*Acer*) the leaves of some species turning to gorgeous color in fall; graceful elms

DECORATIVE

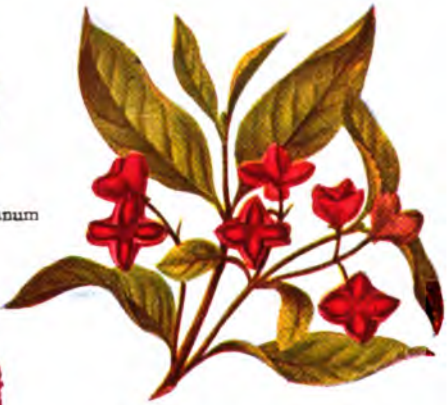

Digitalis purpurea
Abrus precatorius
Bougainvillea spectabilis
Vriesea Wittmackiana
Melampyrum nemorosum
Euphorbia splendens
Warszewitz



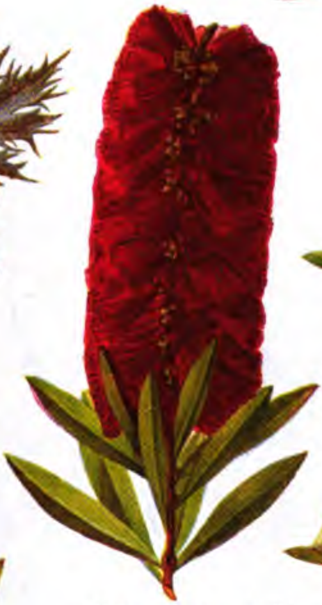
Eryngium alpinum



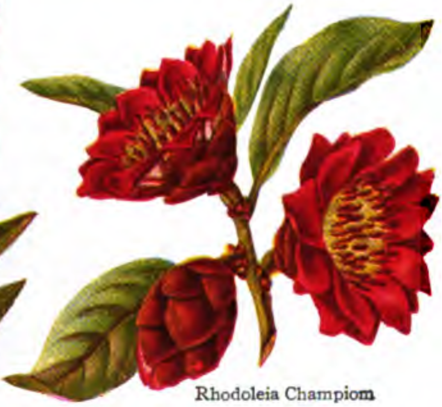
Aesculus hippocastanum



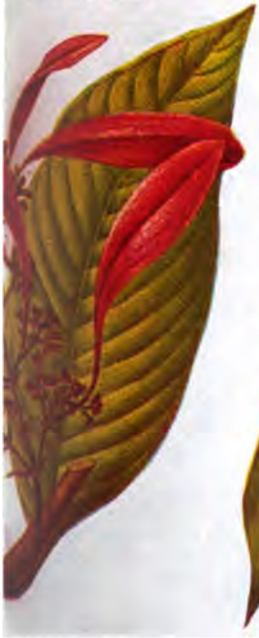
Evonymus curopaea



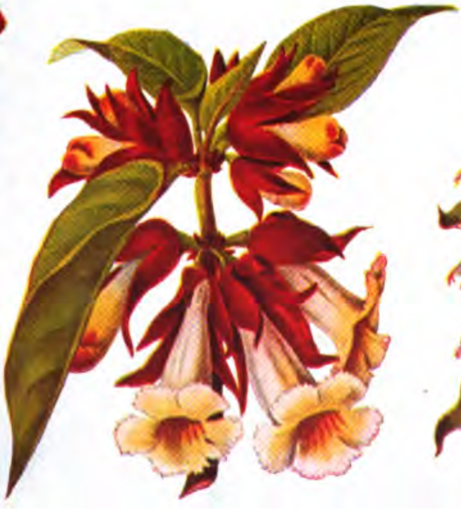
Callistemon angustifolia



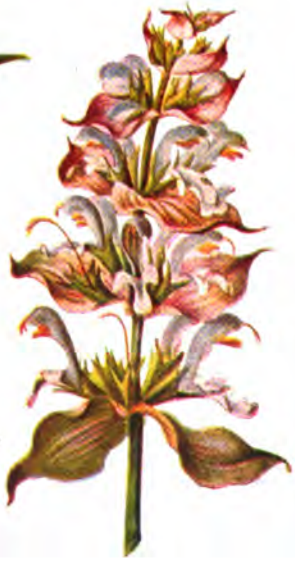
Rhodoleia Champiom



ia cocehea



Alloplectus peltatus



Salvia sclarea

(*Ulmus*) arching over roadways, wherever they can be protected from noxious insects; the tree-of-Heaven (*Ailanthus*), evil-smelling when in bloom, but gay later with huge bunches of pinkish fruits, half-hidden in the compound foliage of this most enduring of all these trees. Rather less common are the Japanese Gingko, a conifer which sheds its fan-shaped foliage in winter; ashes (*Fraxinus*) untroubled by insects; shapely lindens (*Tilia*), fragrant in bloom and humming with nectar-seeking bees, and occasionally other trees like slowly-growing oaks (*Quercus*) and Liriodendrons. Lombardy poplars (*Populus*) and bald cypress (*Taxodium*) are planted for formal gardens; tall, slender and conical they also make good deciduous screens. Coniferous evergreens are planted moreover for screens as well as for windbreaks and ornament, especially the spruces (*Picea*); pines (*Pinus*); firs (*Abies*), and hemlocks (*Tsuga*). Sombre, thick-foliaged cedars (*Juniperus*), Chamæcy-paris, and arborvitæ (*Thuya*), lend themselves to architectural effects, being symmetrical of growth; they are frequently set and trimmed for hedges, taking the place of the old-time slowly-growing yew (*Taxus*) and box (*Buxus*). Privet (*Ligustrum*) is also used much for quickly-growing hedges; also barberries (*Berberis*) brilliant in autumn with arching sprays loaded with oval scarlet berries; the even more interesting holly (*Ilex*); thorns (*Cratægus*), handsome both in flower and fruit; the glossy osage orange (*Toxylon*), and honey-locust (*Gleditsia*), the latter being sufficiently armed with spines Japanese quince (*Cydonia*), flowering gayly, is used for low hedges. The Southwest has thickets of cactus, impressed for impenetrable spiny hedge-rows.

On lawns and in gardens are planted beeches (*Fagus*) some varieties having purple leaves; the «silver-vested birch» (*Betula*) most interesting in its weeping forms; the weeping willows (*Salix*) and Camperdown elms (*Ulmus*) with other «weeping» forms of different trees; sumachs (*Rhus*) holding up their pyramids of scarlet velvety fruit all winter; mountain ash (*Sorbus*), the rowans of Scotland, attractive to all birds when adorned with its bunches of red berries, and repellant to witches if such be about; honey-locust (*Gleditsia*) prodigal of thorns, and of heavy pods filled with sweet pulp hanging amid the delicate compound foliage of the flattened top. These are more conspicuous for foliage and form than for their flowers, but there are a number of available flowering trees. That locust (*Robinia pseudacacia*) called «acacia» in Europe, covers itself with masses of white fragrant pea-blossoms as the compound leaves appear, yielding much honey to bees; even earlier bloom the purple flowers of the Japanese Paulowina, on naked stems, like those of the Sophora, from the same country, which blooms much later, but is scarcely hardy north of New York; and those of the gay redbud (*Cercis*), as well as the white tassels of the shadbush (*Amelanchier*) and the great snowy bracts of dogwood (*Cornus*). Japan sends some of the most exquisite flowering plums and cherries, scarcely more beautiful, however, and not as fragrant as the native flowering crabs (*Pyrus*). Yellow wood (*Cladrastis*), the fringe tree (*Chionanthus*) and the silver bell tree (*Halesia*) are native white flowering trees of much value for small places. Indian bean trees (*Catalpa*) although of Southern origin are frequently seen in Northern parks, where their great panicles of white, streaked, velvety flowers are set off by the huge heart-shaped leaves. The catalpa is apt to be irregular, even sprawling in habit, but the familiar horse-chestnut (*Æsculus*) and its American relatives the buckeyes, are singularly symmetrical in growth, and the former has striking flower-spires of white.

In warmer climes we find live oaks (*Quercus*) dripping with Spanish moss; palms — Washington, Royal, Phœnix and Monterey, and near the coast palmettoes and cocoanuts; Australian eucalyptus, tall with strangely-set foliage and tasseled flowers; handsome liquidambar with star-shaped leaves that turn to red and purple in the fall; the pleasant-fruited pecan (*Hicoria*); mulberries (*Morus*) whose soft fruit is so attractive to birds that the tree is sometimes planted to allure them from more valuable fruits, and luscious figs (*Ficus*). The Pride-of-China tree (*Melia*) is another favorite food-tree of birds who are said to occasionally intoxicate themselves with its rather poisonous translucent berries. Pepper trees (*Schinus*) and the madrona (*Arbutus*) laden with scarlet berries, are also frequented by birds. The crape myrtle (*Lagerstrœmia*) with crinkled petals of rose and white, the blazing royal poinciana (*Poinciana*); the handsome golden-flowered Cassia fistula; the whole tribe of wattles (*Acacia*) including the fragrant-flowered cassie (*A. farnesiana*); the fern-leaved silk-oak (*Grevillea*) and the weird she-oak (*Casuarina*) are well-known exotics frequently planted. Among the natives are the blue-flowered California lilac (*Ceanothus*), the magnificent magnolias and the loblolly bay (*Gordonia*).

The South, again, can have a wonderful collection of flowering shrubs, both native and foreign, some of which are cultivated in the window gardens and greenhouses of the North. Such are the oleander (*Nerium*) bearing great sprays of pink or white or cream flowers; Chinese Hibiscus, or shoe-black plant, tossing its gay flowers with long projecting column out of every shrubbery; the pomegranate (*Punica*), its flowers of pure vermilion followed by heavy fruit that pulls down the slender branches; golden Allamandas, half-climbing in habit, azure phlox-like Plumbago; stiff waxen Ixoras of many hues, the scentless Camellias, and all those shrubs of different families called jessamine, scented and white and waxen of petals. One is the Cape jessamine better known at the North as Gardenia; another is the crape jessamine (*Tabernæmontana*) the rose-bay of India; still another is the Confederate jasmine (*Trachylospermum*) with delightful flowers like tiny children's windmills. Among native shrubs are the Stuartia with large white flowers; the lovely Matilija poppy (*Romneya*); Bauhinias, with orchid-like flowers, gorgeous Lantanas; the sea-side mahoe (*Paritium*), with effective yellow flowers like hollyhocks; Daturas with huge white nodding trumpets and many others.

The calico bush (*Manzanita*) thickly bedecked with fragrant white bells (*Arctostaphylos*) also noted for the rich color of bark and twigs; the extraordinary tree-yuccas (*Yucca*); Californian holly (*Heteromeles*), whose cardinal-berried sprays are used for Christmas decoration; that barberry (*Berberis*), with holly-like foliage, called most frequently Mahonia; the golden-flowered Fremontia; the tree-mallow (*Lavatera*); the tasseled Garrya; and the fragrant California laurel (*Umbellularia*) are often seen in Western and Pacific Coast plantations.

There is, however, no lack of flowering or fruiting shrubs for the more severe climates, and a certain amount of garden-color may be procured for even the dreary winter season, by planting broad-leaved evergreens, such as the stiff formal box (*Buxus*); hollies (*Ilex*); mountain laurel (*Kalmia*) and Rhododendron, the last two being even more desirous when in bloom. Dwarf conifers also, as the spreading Canadian yews (*Taxus*), junipers (*Juniperus*) and low pines (*Pinus*) form masses of grateful green in the foreground of shrubberies. Certain cornels (*Cornus*), which bear cymes of pretty flowers in summer, followed by white or blue fruit, are remarkable for their brightly colored twigs in winter; likewise willows (*Salix*), brightening toward spring, and Kerria, are useful for their tinted bark.

All those shrubs which bear winter berries are also important for color; they include sumach (*Rhus*); burning-bush (*Euonymus*) and its allies; barberries (*Berberis*); wild roses (*Rosa*); and deciduous hollies, especially that known as black alder; wax-myrtles and bayberries (*Myrica*), most of which also afford a winter fare for hard-weather birds. Others that are tempting to the avian palate, but which mature earlier are the spice-bush (*Benzoin*); choke-cherries (*Prunus*); red- and black-fruited elderberries (*Sambucus*); oleaster (*Eleagnus*); service-berries (*Amelanchier*); buckthorn (*Rhamnus*); sea-buckthorn (*Hippophæ*); buffalo berries (*Shepherdia*) and the white fruited snowberry (*Symphoricarpos*).

Among the flowering shrubs one can have blossoms in early spring on fragrant mezereon and Daphne (*Daphne*); on the sweet-scented Asiatic bush honey-suckles (*Lonicera*); on the drooping golden bell (*Forsythia*), and the scentless yellow jasmine (*Jasminum nudiflorum*). These are swiftly followed by pink and flaming azaleas; by the chocolate-colored, spicily-fragrant "Sweetshrub"; by Golden-flowered Kerria; by lilacs (*Syringa*) in all shades of purple and white; by flowering almonds (*Prunus*) and graceful snowy Deutzias; Kalmias and Rhododendrons come in June and July with a gorgeous company of Spiræas, some with hemispherical heads of white, some shooting up into spires of pink tiny blossoms. Huge snowballs (*Viburnum*) follow, the old-fashioned guelder-roses and the equally well-known Rose-of-Sharon (*Hibiscus*), tree-like covered with flowers like hollyhocks, pink or white. Single wild roses (*Rosa*) as the pink prairie-rose, the eglantine with lemon-scented foliage, and the robust Japanese roses are suitable for hedgerows, in company with heavily scented mock-oranges (*Philadelphus*); pepper-bush (*Clethra*) and late white Azaleas; and with the scentless but floriferous raspberries (*Rubus*); garlanded pink Weigelas (*Diervilla*); the blue-spired Buddleia, delightful to butterflies; the smoke-like puffs of Rhus Cotinus and the heavy heads of Hydrangeas of ever-changing tints.

The seashore claims its own peculiar shrubby flora. Among those shrubs that may be planted along the dry strand are feathery Tamarix, each spray tipped with a wand of delicate rosy bloom; the native dark-colored aromatic bayberry (*Myrica*), dense clusters of high-water shrub, (*Iva*), fleshy-leaved like its neighbor, the Baccharis, which in autumn is smothered in white down of its fruits; and where the climate permits, wattles (*Acacia*) that are excellent sand-binders. Beach-plums wreathed with white bloom in early spring, hung with blue fruit in fall, and the creeping matted bearberry, thickly studded with scarlet berries, will thrive in sandy wastes.

Vines carefully trained over trellis or wall or tree are valuable for ornamental as well as for the more prosaic purpose of screens. Since their methods of ascension are different, these must be taken into consideration. Virginia creeper and its familiar relative, the Boston ivy (*Ampelopsis*) raise themselves by sucker-like discs at the end of tendrils, and are especially suited for creeping up walls, rocks and tree-trunks. European ivy (*Hedera*) and the American creepers (*Tecoma*) which ascend by thrusting out aerial rootlets, are equally adaptable for this use. Other common vines climb by tendrils or by weaving, twining or scrambling and are therefore useful for twisting about wires, or weaving into the meshes of a trellis. Wistarias are familiar examples of this sort, often becoming in age self-supporting, dropping their heavy purple and white racemes from tree-like trunk and branches. Bittersweet (*Solanum*), covered with purple star-flowers in summer and with yellow and scarlet berries in fall; honeysuckles (*Lonicera*) prodigal of scented yellow or pink or white blossoms or unscented red ones; Clematis, bearing either large formal flowers of white or purple, or small clusters of small white ones of the type known as traveler's joy, succeeded by gray fluffy seed-balls of feathery-tailed fruit; fragrant cinnamon vine (*Dioscorea*); matrimony vine (*Lycium*) throwing out long wands freighted with scarlet berries; Akebia quinata, delicate in foliage and gay in fruit; far-scrambling wild cucumber (*Echinocystis*); and humble gourds of all shapes with the hop (*Humulus*), laden with pale fruit, form verdurous screens.

Our wild bittersweet, or wax-work (*Celastrus scandens*) gorgeous with scarlet and gold far into winter; the delicate mountain-fringe (*Adlumia*) with its fern-like foliage and pink, saccate blossoms and the ground-nut (*Apios*) wreathed with violet-scented balls of old-rose tinted blossoms, are perhaps best left to garland fence and hedgerow. Climbing roses, such as the Baltimore Belle, the ubiquitous ramblers and various hardy hybrids are useful for trellis and garden arches, one of the best being the native prairie-rose (*Rosa setigera*) and its varieties. The South, however, can grow a number of climbing roses like the deliciously fragrant yellow Marechal Niel, the Gloire de Dijon and the wonderful single white Cherokee rose which takes possession of hedges. They have also the fragrant yellow jessamine (*Gelsemium sempervirens*) and the exotic star-flowered, perfumed white jasmines (*Jasminum*) as well as the tropical Solanums with large blue flowers.

Climbing also in those favored lands are the incomparably blue Clitoris ternatea, purple and brick-red Bougainvillæas, smothered by their papery triple bracts; the gayly-colored climbing lily (*Gloriosa superba*), shell-pink rosa-de-montana (*Antigonon*) flinging its branched coral-like sprays in wild profusion; Clerodendrons with scarlet corollas peeping out of white bag-like calyxes; Thunbergias, some small, white or yellow with purple eye, some huge of leaf, fringed with long racemes of gigantic velvety flowers of white or purple. They have, too, quaintly-flowered Aristolochiæ, grotesquely shaped, strikingly reticulated with pale veins on a purplish or brownish velvety ground.

Convolvuluses are rampant in tropical climes, and great moonflowers, and the satiny chalices of pink and white and blue are common there, as well as the charming cypress-vines (*Ipomœa*) with delicately cut foliage, which are grown at the North as annuals.

If the size of the place prohibits the use of many trees or even of shrubs, there are still a number of perennial plants that are large and conspicuous enough to be truly decorative. Pæonies form an important group of extremely hardy herbaceous plants, being found in many single and double varieties and as many hues, often rose-scented, moreover. Irises are a close second, having a bewildering number of species, types and colors, a constant succession of varieties being obtainable from early spring to midsummer. Lilies (*Lilium*), too, include many species of many colors, but always decorative and graceful, very often fragrant. Daylilies (*Hemerocallis; Funkia*) are also very decorative and form huge clumps, the orange and yellow varieties liking moisture and full sunshine, while the white and blue kinds prefer shade: this preference is shared by fragrant lilies-of-the valley (*Convallaria*) which carpet wide ground-space, and by evergreen, trailing periwinkles (*Vinca*) starred with purple blossoms in early spring. Some of the members of that large group, Campanula, both blue and white, also like shady places, and one species, the bluebells of Scotland is never so happy as when perched on rocky slopes or cliffs. It is one of the best plants for a simple rockery, sharing the damp stony location with dancing columbines (*Aquilegias*). Rosetted Saxifrages and Sedums, trailing Phloxes, sweetscented Daphne, and the scrambling rose (*Rosa wichuriana*) are all fit subjects for the sunnier aspects of a rockery, or for hot banks.

Aconites with cowl-like flowers of rich purple or yellow, Virginia bluebells (*Mertensia*); tall white Phloxes. and fragrant sweet rocket (*Hesperia*); scarlet and violet bee-balms (*Monarda*); and the stately foxgloves (*Digitalis*) are striking border plants for more or less shady places. In the full sun we may find the annual humble but glowing sunflower (*Helianthus*) splendid screening plants; azure larkspurs (*Delphinium*), ever a lure for humming birds; gray-green grass-pinks (*Dianthus*) profuse of fragrant bloom in June and evergreen throughout the winter, and the picturesque hollyhocks (*Althæa*). Hardy old fashioned pompon Chrysanthemums bloom gorgeously far into fall undisturbed by frosts, the stiff papery flowers of immortelles, the satin discs of honesty (*Lunaria*), and the vermilion, inflated calyxes of the Chinese lantern plant (*Physalis*), lend their cheer to the late garden, followed by the stiff waxy blossoms of the Christmas rose (*Helleborus*).

Southern climates permit of the culture of green-white Eucharis; Pancratiums and Crinums of varied hues: of viciously-armed Cacti and the stiff Aloes, Agaves and Yuccas, extremely decorative with their formal tufted growth and pyramidal bloom. There hothouse plants of the North, Heliotropes, Fuchsias, Begonias and Geraniums, become bushes, and the tea-rose blooms perpetually. They have also the gaudy dwarf Poinciana and the even more brilliant Poinsettias and Acalyphas (*Arundo*). Shrubby lantanas choke roadsides, and Bamboos and giant reeds form thickets.

Swampy lands and quiet pools, natural or artificial, filled with tepid water and with goldfish for the reduction of mosquitoes, can be turned into most decorative features, as bog- or aquatic-gardens. In the moist soil of the bog-gardens can be planted a variety of native plants such as the purple ironweed (*Vernonia*); the old-rose gigantic Joe-Pye-weed, and its smaller congener, the massive-headed, white boneset (*Eupatorium*); the vivid cardinal flower (*Lobelia*) and its blue relative; the pale turtle-head (*Chelone*) topheavy with its long continuing masses of oddly-inflated blossoms; yellow and magenta Lysimachias; goldenrods (*Solidago*); Asters and some of the more conspicuous orchids. The flaunting rose-mallow (*Hibiscus*), and marshmallow (*Althæa*) may also be suggested. The most splendid aquatic plants are in the genus Nelumbium, or lotus, our native species being pale yellow and the Oriental, pink or white, raised high in the air over huge umbrella-like leaves. Various waterlilies (*Nymphæa*) some hardy, and others tender, in the North, float on the surface of the pond, with the humble spatter-dock and the purple water-hyacinth (*Eichornia*) which is become such a pest in Southern water-ways, and gay water-poppies (*Limnocharis*).

Tall blue spikes of pickerel-weed (*Pontederia*) and the white fugitive flowers of the arrow-head (*Sagittaria*) and tufts of umbrella plant and ancient papyrus (*Cyperus*) rise above the water. Consult Bailey, L. H., 'Cyclopedia of American Horticulture' (New York 1904); 'How to Make a Flower Garden' (New York 1903).

HELEN INGERSOLL.

PLANTS, Physiology of. Since the plant is the ultimate source of all of the world's food, the study of the processes by which these substances which serve for food for man and beast are built up from the elements is exceedingly interesting and highly important. That is Plant Physiology. It is important because of its value in increasing food production. But apart from the utility of the study there is also an æsthetic value. There is keen pleasure in learning by observation and experiment how plants live and grow and reproduce their kind and incidentally supply food for the world.

As will be seen from a brief history of the development of the subject the scope has been extended gradually with increase of knowledge, and the particular aim in the study of the subject changes with different times and conditions. The aim of the first plant physiologist, Stephen Hales, is given in the preface to his book 'Vegetable Staticks' (1726): «Since we are assured that the all wise Creator has observed the most exact proportion of number, weight and measure in the make of all things; the most likely way therefore to get any insight into the nature of these parts of the creation which come within our observation must in all reason be to number, weigh and measure.» Most of the early observers in plant physiology were interested in recent discoveries in animal physiology and were curious to see if plants behaved similarly. Hales compares the «quantities of moisture perspired» by plants and trees with the amount perspired by a man; the perspiration of a 160-pound man is to the perspiration (transpiration) of a sunflower plant as 141 to 100. Also after he had determined the force of blood in the arteries of dogs, he measured the pressure of the sap in grape vines. Again, Hales found that there is no circulation of sap in plants similar to the circulation of blood in animals, but that there is free movement of the sap upward and laterally. These few examples serve to show the general attitude of the first experimenters in plant physiology.

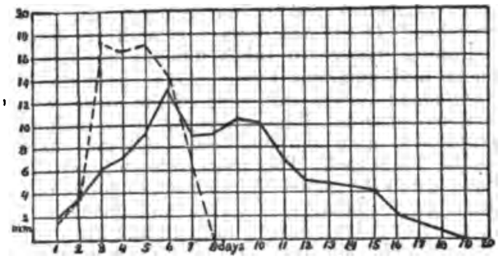


FIG. 1.— Graphs showing daily growth. The unbroken line represents the daily growth in millimeters of Fritillaria stem. The broken line represents the daily growth of the root of Vicia faba. The vertical extent represents the number of millimeters of growth, and the horizontal extent represents the number of days during which the growth was taking place.

In 1779 Ingen Housz, a physician, discovered that all plants give out carbon dioxide and absorb oxygen as animals do in respiration, and in addition to this that the green leaves absorb carbon dioxide and give off oxygen. This process is peculiar to plants and is the source of the carbon used in the manufacture of sugars, starches and other carbon compounds in the plant.

About 1800 Theodore de Saussure made quantitative analyses of the ash of many plants. By growing plants in watery solutions of the mineral substances found in the ash, he proved that some of these are necessary for growth. He also showed that nitrogen, one of the necessary elements, is obtained by plants from the soil and not in gaseous form from the air as had been thought. Boussingault in 1840 made an extensive series of experiments based on those of de Saussure and proved that the mineral substances necessary for plant growth are nitrogen, phosphorus, sulphur, potassium, magnesium, calcium and iron besides carbon which is obtained from the carbon dioxide of the air.

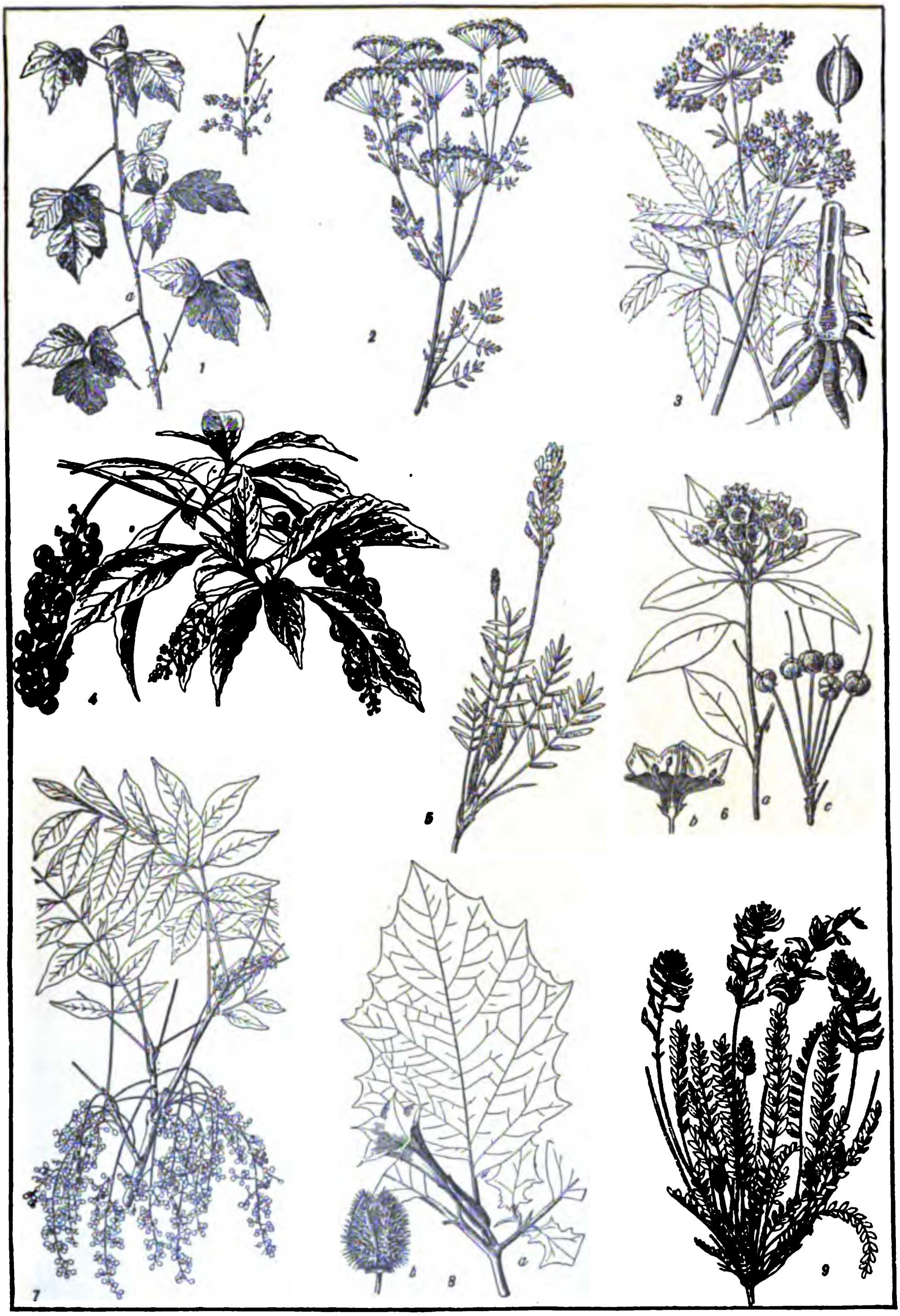
Although the foregoing important facts about the physiology of plants were discovered before 1850 they were not widely known. About that time Sachs, the first great teacher of plant physiology, collected all the isolated data, organized them and published them in his lectures on Plant Physiology. This was the real beginning of plant physiology as a science.

During the next 50 years plant physiologists were chiefly interested in quantitative measurements of the different life processes. New apparatus was developed to make these measurements more exact. One of these was the self-recording apparatus for measuring the rate of growth, first used by Sachs. The rate of growth per hour of roots and stems was determined for many plants. The rate of absorption of water by roots, the rate of flow of sap through trees and the amount of water loss per hour per square metre of leaf surface — all were determined for various plants. Sachs demonstrated the formation of starch in green leaves in the light and its disappearance in darkness, simply by putting the leaves in iodine solution. If starch is present they become blue, if not they stain yellow. Measurements were made of the amount of starch formed per hour per square metre of leaf surface.

An important piece of work of this period is that of Pfeffer (1877). In an attempt to find what physical forces are available to do work in the plant, he measured the pressure which sugar solutions exert when separated from water by a membrane. This is the condition in root hairs: the cell sap (sugar solution) is separated from the water of the soil by a membrane. Pfeffer found that the pressure is proportional to the concentration of the solution. The pressure in plant cells varies from four to 50 atmospheres.

A phase of physiology which received much attention during this period is that of plant movements. From early times people had been interested in these movements. The turning of stems toward the light, the drooping of the leaves of the sensitive plant on contact, the movements of tendrils and twining plants — all these attracted the attention of the observer. There were attempted explanations of the mechanical force involved in the curvatures. Ray in 1693 thought that all curvatures were due to differences in temperature on the two sides,— that the warmer side grows more rapidly, and, therefore, becomes convex. In 1806 Knight by ingenious experiments proved that the upward growth of stems and the downward growth of roots is due to the influence of gravity. He grew germinating seeds on a centrifuge, which was revolved rapidly, thus substituting centrifugal force for the force of gravity. The roots grew in the direction of the centrifugal force, the stems in the opposite direction. Now followed a period when «vital force» was offered as an explanation of plant movements, or indeed of any plant behavior which was not understood. Sachs scorned the vital force conception and initiated experiments to discover the physical or mechanical basis for plant movements. Unfortunately before any real progress had been made, the «stimulus» conception was offered as sufficient explanation. Light acts as a stimulus, therefore stems turn toward it. Gravity acts as a stimulus, therefore roots grow downward. A vast number of use-

AMERICAN POISONOUS PLANTS



1 Poison Ivy (Toxicodendron radicans): *a*, spray showing aerial rootlets and leaves; *b*, fruit
2 Poison Hemlock (Conium maculatum), showing flowers and seed
3 Water Hemlock (Cicuta maculata), showing section of spindle-shaped root and lower stem, the leaves, flowers, and fruit
4 Pokeweed (Phytolacca americana)
5 Stemless Loco-weed (Oxytropis lamberti), in flower
6 Broad-leaf Laurel (Kalmia latifolia): *a*, flowering spray; *b*, vertical section of flower showing peculiar attachment of stamens (enlarged); *c*, fruiting capsules
7 Poison Sumac (Toxicodendron vernix), showing leaves and fruit
8 Jimson-weed (Datura stramonium): *a*, flowering spray; *b*, fruiting capsule
9 Woolly Loco-weed (Astragalus mollissimus)

less experiments on movement were made during this period. Since 1900 plant physiologists are seeking to find, not necessarily the *cause* of movements, but those chemical and physical changes within the organ which precede and accompany the movements. An important discovery is that of Lepeschkin (1910). He found that the cells in the upper side of the swelling at the base of bean leaves are more sensitive to light and darkness than those in the lower side. In the light the cell membranes in the upper half become more permeable, therefore the cells lose some of their sugar, and become flaccid; the upper side becomes concave and the leaf rises. In darkness the opposite process takes place: cell membranes become less permeable, therefore the cells retain their sugar and absorb more water; this causes the cells to swell; the upper side becomes convex and the leaf droops.

From 1900 up to the present there has been a rapid increase in knowledge of the chemistry of plant life,— of the chemical constitution of the sugars, proteins and many other substances which are found in plants; also, and this is much more important, an increasing knowledge of the chemical and physical processes which are going on in the living plant. In his work the plant physiologist now makes use of all the methods and apparatus available from the sciences of physics, organic and physiological chemistry. The close relation between the science of plant physiology and the arts of agriculture and horticulture is now being recognized, and the facts discovered by the plant physiologist are made use of in agricultural and horticultural practice.

The progress in the attitude of plant physiologists with increasing knowledge may be illustrated by the questions which they have sought to answer concerning a single plant organ — the green leaf. Before 1850: What is the function of the leaf? What the function of the green color?

From 1850 to 1900: What is the amount of work done by the leaf? The amount of starch formed per hour? The amount of water lost per square metre of surface? The amount of carbon dioxide absorbed and oxygen given off in the light? The amount of oxygen absorbed and carbon dioxide given off during respiration?

From 1900 to 1918: What are the physical and chemical processes by which sugar is made in green leaves? What conditions of soil and what proportion of mineral substances are necessary for the production of the greatest amount of sugar in leaves? What is the ratio between the sugars and mineral substances, especially nitrates, in the plant which cause fruitfulness?

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PLANTS, Poisonous, those inflicting toxic disease upon men or animals. The most widely dreaded toxic plants in America are probably those poisonous to the touch. Such are the poison ivy or the poison oak and the poison sumac, otherwise known as the poison elder or poison dogwood. All of them affect certain constitutions most disastrously, containing, even when dried, an oil which, soon after touching the skin, raises a severe inflammation, and produces an intolerable itching, especially where the skin is callous, or there is friction. Immediate washing after contact with the plant will sometimes prevent the trouble, and very hot soap suds, or sugar of lead, will alleviate the suffering. The poison seems most virulent when the plants are blooming.

The above all belong to the genus *Toxicodendron,* and are continually being confused with innoxious plants, the Virginia creeper, for instance, often being destroyed with the poison ivy, the two vines sometimes growing together. This poison ivy is a climbing or trailing shrub (sometimes erect), with variable three-foliate leaves, aerial rootlets and greenish flowers. The smooth, greenish berries often remain on it until late in the winter, forming a food for birds, which disseminate the plant. The leaves differ from those of the Virginia creeper in having only three leaflets instead of five, and they are of a peculiar dark green, and glossy as though waxed. The poison ivy grows everywhere, in open brush, in ravines and on the borders of woods; it climbs tall trees, and luxuriates in fence corners, often rearing its head high above the posts. In autumn it assumes brilliant colors, and is oftentimes picked for ornament,— with unfortunate results.

The poison sumac grows in swamps from Florida to Canada and westward to Louisiana. It is a tree-like shrub, 6 to 30 feet high, with long pinnate leaves having from 7 to 13 smooth and glossy leaflets, on red petioles, and without marginal teeth. The wood has a faint sulphurous odor, which, together with the leaf scars, which are very prominent, enables one to distinguish the plant from other shrubbery in the winter. The loose, grape-like bunches of silver-gray berries are also visible in the winter and are a frequent source of poisoning, being picked for ornament.

The western poison-oak has the same unpleasant toxic characteristics, and differs from the poison ivy mainly in the character of its leaves, which are thicker and smaller, and less sharply lobed.

Other plants, less common, but quite as virulent to some people, are the handsome ladies' slippers, the largest, the crimson and white *Cypripedium reginæ,* growing in sphagnum swamps, producing almost identically the same symptoms as the sumacs. The juice of several spurges (*Euphorbia*) excites similar inflammations.

Plants having poisonous fruits are perhaps the most dangerous, especially to investigating children. There are several kinds of berries, like those of the pokeweed, bitter sweet and night shade, and the black cherry kernels, which are poisonous, when eaten rashly, but the most destructive fruit is probably that of the thorn-apple, or Jimson weed (*Datura*)— a fruit most unappetizing in appearance, covered with spines, and holding hard black seeds, containing several poisonous alkaloids. The plants are rank and ill-smelling smooth and bushy annuals, with large irregularly flaccid leaves, and large flowers, white or purple according to species, blooming at night, and resembling half-opened, long-tubed morning-glories. They are found on waste lands and rubbish heaps.

The water-hemlock (*Cicuta maculata*) is also responsible for many deaths. It belongs to the great carrot family, which contains both edible and poisonous roots and seeds. It is a smooth erect perennial, three to eight feet high, with a rigid, hollow stem, marked with purple lines, numerous branches, finely dissected leaves, tiny white flowers, disposed in the familiar flat umbels of the wild carrot or sweet cicely, and a cluster of spindle-shaped roots, which vary in length from one and one-half to three inches, and are very characteristic. This is one of the most poisonous native plants in the United States, being rapidly fatal to both man and animals. The roots are especially dangerous, because the taste, being aromatic and to some people suggesting that of horseradish, parsnips, artichokes or sweet cicely, is apt to lead children to eat them when they are found forced out of the soil by washing, freezing or other causes in early spring. Cattle sometimes eat the tubers, and in marshes they are poisoned by drinking water contaminated by the juice of roots which have been crushed by being trampled upon. No estimate can be made of the amount of damage done to livestock, but it is very considerable. The human victims average several per annum.

The historic poison hemlock of Greek fame is another violently poisonous plant, in all its parts. Similar in appearance to the other hemlock, with purple spotted stems, and a mouse-like odor when bruised, it is becoming naturalized in waste places, and is dangerous when seeds, foliage or roots are eaten.

The beautiful evergreen mountain laurels (*Kalmia*) conceal a strong poison in their leaves, as do other closely related species of the Heath family, such as the *Rhododendron*. The smaller laurel, *K. angustifolia*, carries the suggestive name of lambkill. Livestock are the principal sufferers from these plants, scores being poisoned and killed by them annually, but children are sometimes poisoned by eating young shoots, which grow with and closely resemble wintergreen, but are without the spicy flavor of the latter. Honey is said to be rendered poisonous when bees feed upon the *Kalmia* pollen.

Livestock are also often killed by eating the poisonous fruits of the buckeye (which with the young shoots were bruised and thrown into ponds, stupefying fish and rendering their capture easy); they are also poisoned by the leaves of the black cherry, especially when wilted.

In the West the sneezeweed (*Helenium*), the larkspurs, rattlebox and the loco- or crazy-weeds are the dread of stock-raisers. The latter (*Astragalus*), silvery-white, silky-leaved perennials, have a most peculiar effect on horses. It is not an acute disease and has two recognized stages. The first, which may last several months, is a period of hallucination or mania accompanied by defective eyesight, during which the animal may perform all sorts of antics. After acquiring a taste for the plant it refuses every other kind of food, and the second stage is ushered in. This is a lingering period of emaciation, characterized by sunken eye-balls, lustreless hair and feeble movements. The animal often dies, finally, as if from starvation.

Human beings occasionally poison themselves by cooking various plants in mistake for the harmless "greens" or salad plants. Toadstools, perhaps, cause as many poisoning cases as any other plants. The attractive-looking Amanitas are continually being gathered by careless or ignorant people in mistake for the true edible mushrooms, and very often cause death.

PLANTS, Recapitulation in. The term, recapitulation, in plants and also in animals, is used to designate features of the embryogeny and early development of the individual. "Ontogeny recapitulates phylogeny" is the usual classroom term, meaning that the individual, in its own development, repeats the history of the race. The frog is first a pollywog and then tadpole, before it finally reaches the adult stage. This is interpreted to mean — according to the recapitulation theory — that the frog's very remote ancestors were adult at the pollywog stage; and that its less remote ancestors were adult at the tadpole stage. The frog, in its individual life history, repeats these phases of its ancestry. Zoological literature is full of illustrations. In plants, illustrations of recapitulation are just as numerous, but are not so widely known. In many trees and shrubs, the early leaves of the seedling are quite different from the leaves of the adult plant. The Ginkgo, or Maiden Hair Tree, offers a good example. The leaves of the adult tree have an even, wedge-shaped outline (Fig. 1, *D*) or have a notch at the apex (Fig. 1, *C*), the latter condition suggesting the specific name, *biloba*, the scientific name being *Ginkgo biloba*. The leaves of the seedling, and also the leaves at the tops of young trees, do not have such a simple outline, but are deeply cleft (Fig. 1, *B*). This is significant, for the geological ancestors of Ginkgo — like the *Baiera* — have just such cleft leaves at the adult stage (Fig. 1, *A*). In the common larch (*Larix*) the seedling has simple, needle leaves, and such leaves are found on the first year's growth from any bud on the

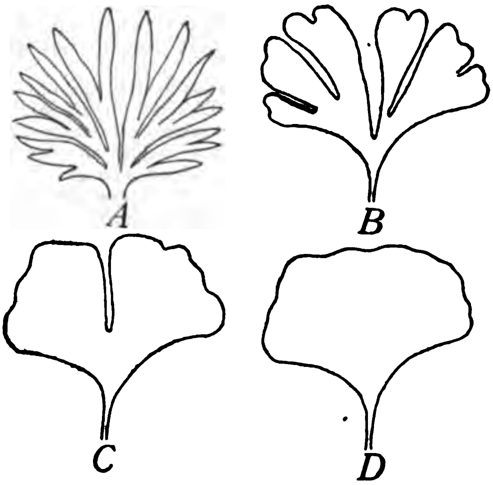

Fig. 1.

tree; but later, the leaves appear in dense clusters on short spurs. In the pine, the seedling has short needle leaves, but later the leaves are longer and occur in twos, threes or fives on short spurs. Examples might be multiplied. The early form of leaf is called a «juvenile» leaf, and many believe the seedling is passing through a stage which characterized its adult ancestors. All Pteridophytes (ferns and fern allies), which have two kinds of spores, furnish excellent illustrations of recapitulation. *Selaginella*, a very common greenhouse plant, may be taken as an example. In its early development, the megasporangium is just like the sporangium of a common fern which is to produce only one kind of spore. In *Selaginella* itself, the microsporangium looks very like the sporangium of a common fern. All of its spores reach maturity. In the megasporangium, the spore tissue develops just as in a fern and mother cells round off, as if to produce the usual four spores; but only one mother cell undergoes the expected division, giving rise to four spores, while all the rest of the mother cells disorganize and their substance is absorbed by the four spores. *Selaginella* repeats an ancestry in which the spores were all alike and all functioned. The protonema of a moss repeats an algal ancestry. In the Algæ, illustrations are numerous. The common kelp, *Laminaria*, in its early development, has a small, flat blade, and in the adult plant the blade has simply grown larger. In *Nereocystis*, one of the Giant Kelps of the Pacific Ocean, the young plant has the simple blade, but the adult form is much more complex. Compare Fig. 2 *A* and *B* with Fig. 3 *A* and *B*.

FIG. 2.

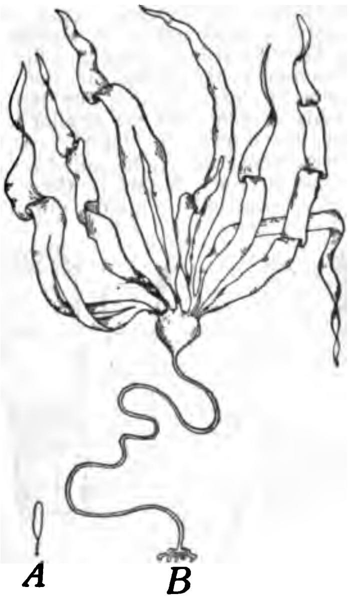

FIG. 3.

FIG. 2.—*Laminaria*. A, sporeling. B, adult form.
FIG. 3.— *Nereocystis*. A, sporeling. B, older but not yet adult form.

The Fucaceæ, the family to which *Fucus*, the most familiar of all brown seaweeds belongs, offer a fine illustration in the microscopic details of recapitulation. In the oogonium of *Focus* eight nuclei are formed and each nucleus becomes the centre of an egg. In most of the other genera of the family, the eight nuclei are formed, but some of them disorganize, so that the mature oogonium contains only four or two eggs, or even only one. *Fucus* shows the ancestral condition. The others pass through the Fucus stage on account of this phase of heredity known as recapitulation. In studying the relationships of great groups, orders, families, genera and even species, recapitulation furnishes valuable suggestions. Consult Wilson, E. B., 'The Cell in Development and Inheritance'; Spencer, Herbert, 'The First Principles of Evolution.'

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PLANTS, Regeneration in. The subject of regeneration has received much more attention from zoologists than from botanists. It has long been known that if the leg or tail of a salamander be cut off, a new leg or tail will be formed, or «regenerated.» If an earthworm be cut into three pieces, the anterior piece will develop a tail; the posterior, a head; and the middle will develop both a head and a tail. These illustrations indicate the general application of the term, regeneration, in animals.

In plants, the term has been applied rather loosely, but in some cases a missing part may be replaced, or regenerated and the term, regeneration, might well be limited to the replacement of an organ or structure which has been removed, as in the case of the replacement of a leg in the salamander. In some plants, if the apex of a root be cut off, the missing part will be restored (Fig. 1, *A* and *B*), but if the cut be too far back from the apex a new root tip is not restored, but new roots develop a short distance behind the cut surface (Fig. 1 *C* and *D*). If the shoot of a common dandelion be cut off some distance below the leaves new shoots develop from the cut surface of the root. Many plants with strong, fleshy roots behave in this way. If a vigorous willow twig be cut off and the cut end be placed in soil or in water, roots will develop from the lower part, just above the cut surface (Fig. 2). If the part in the water has buds, roots may develop at the lower part of the bud.

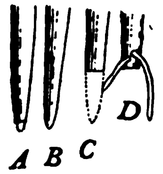

FIG. 1.— Regeneration in roots; a small portion cut off (A) is restored (B); a larger portion, cut off (C) is not restored, but new roots form above the injury (D).

From stumps of trees it is very common to find new shoots developing and they may even develop into trees. It used to be assumed that such shoots come from dormant buds, but it is now known that in most cases there are no such buds in the region from which the shoots originated. They come from the cambium or from embryonic tissue induced by the wound. In «pollarded» willows many of the shoots arise in this way, although some come from buds already present. In the cycads, buds develop from almost any wounded portion of the trunk, the bud arising from the cambium or from embryonic tissue due to the wound. In this case, dormant or latent buds are entirely out of the question, because the cycad stem has only one bud and that one is terminal. The underground stem of the cycad, *Zamia*, may be cut into several pieces and shoots will develop from the cut surfaces. This case is different from that of the potato, for the potato, as it is cut for planting, has several eyes or buds in each piece from which the new plants are formed.

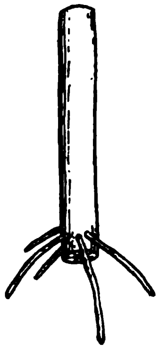
Fig. 2.—Behavior of Willow twig when cut off and placed in water.

Many plants are propagated from cuttings. In the *Begonia* or *Bryophyllum*, the leaf is cut into several pieces and a whole new plant is developed. This behavior differs from that noted in the salamander where a new leg grows and replaces one which has been cut off, for the piece of a leaf does not replace the missing parts and become a whole leaf, but produces a bud and a root which develop into a complete plant.

While a great deal of observation and a considerable amount of investigation has been done along the lines indicated, the term regeneration is so elastic that botanists still use it in describing the various cases to which we have referred.

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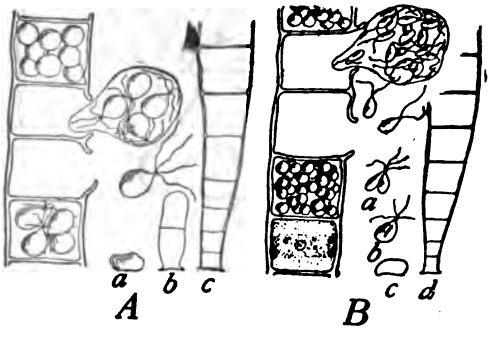

Fig. 1.— *Ulothrix*, one of the green algæ. *A*, portion of a filament, at the left, showing cells producing zoospores: *a*, the zoospore has lost its cilia; *b*, zoospore has elongated and divided; *c*, further divisions have resulted in the formation of a filament. *B*, cells producing gametes: *a*, two gametes uniting; *b*, the cell formed by the union; *c*, cilia have been resorbed; *d*, a filament has been developed. Greatly magnified.

PLANTS, Sex in, Origin, Evolution and Determination of. For the origin of sex and the early stages in its evolution, one must turn to the algæ and fungi, since all plants from the liverworts to the sunflowers and orchids have already reached that degree of development which is characterized by eggs and sperms. In lower members of the algæ, reproduction by swimming spores is common. Repeated divisions within a cell give rise to several nuclei, each surrounded by a mass of protoplasm. (See Cell; Chromosome and Protoplasm). Each mass of protoplasm, with its nucleus, becomes transformed into a swimming spore, which owes its motility to thread-like cilia. The spore comes to rest, elongates and then divides transversely. By repeated divisions, a filament like the parent plant is built up (Fig. 1, *A*). In *Ulothrix,* which is commonly used for illustrating the origin of sex, the zoospores are formed, 1, 2, 4, 8 or 16 in a cell. If one, two or three more divisions take place — the cells divide simultaneously — so that 32, 64 or 128 cells are produced, the cells develop into the motile condition but seem too small and deficient in energy to divide. However, they unite in pairs — for which reason they are called gametes — their protoplasm fuses into one mass and the two nuclei blend into one. The result of the union is a vigorous cell which may at once develop into a filament like that produced by the zoospore, or may produce a few zoospores, which then behave like those formed in the cells of a filament (Fig. 1, *B*). Thus the gamete habit originated from the zoospore habit, and sexuality, characterized by the fusion of two gametes, represents an advance beyond the zoospore condition. The zoospore is the ancestor of the gamete. The gamete habit arose from the zoospore habit independently in various algæ and fungi. In the illustration just given, the two gametes are of the same size and shape; but, after the gamete habit became established, the gametes began to differ, one remaining small and active, and the other growing larger and less active and finally losing the swimming habit. When the two gametes have begun to differ in size, the terms, male and female, may be used, the smaller being the male and the larger the female; also, the male gamete may properly be called a sperm and the female an egg. Stages in the evolution from similar gametes to highly differentiated eggs and sperms may be illustrated by *Cutleria,* one of the brown algæ, in which the egg, although motile, is much larger than the sperm. In *Oedogonium,* a very common green alga, the egg is immensely larger than the sperm and has not only lost all motility, but remains in the cell (Fig. 2, *A* and *B*). From this stage in the evolution of sex, the egg is always retained in the organ which produced it, further development being more conspicuous in the organs which produce and nourish the eggs and sperms than in the eggs and sperms themselves. In liverworts, mosses, ferns and their allies, and in most Gymnosperms, the organ which produces the egg is called an *archegonium* and that which produces sperms is called an *antheridium,* although in the Gymnosperms the antheridium character is not so obvious to the layman.

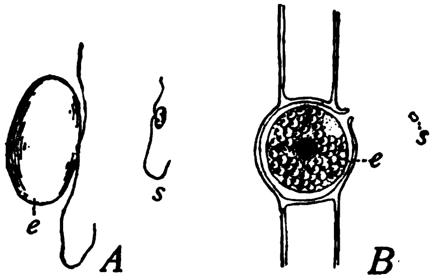

FIG. 2.—*A, Culleria: e,* egg; *s,* sperm. *B, Oedogonium: e,* egg; *s,* sperm.

In the Gymnosperms the eggs arise in structures concealed in large cones and the sperms are finally developed from spores which were produced in smaller cones. We have no hesitation in calling these larger cones female cones and the smaller ones male. In the same way we should call the ovaries of the Angiosperms female organs and the anthers, male. When ovaries and anthers are formed on separate plants, as in the willows and many others, we believe it is perfectly correct to speak of male and female trees. Some botanists object to using the terms male and female, except as applied to the gametophyte generation. (See ALTERNATION OF GENERATIONS). The determination of sex is a problem which is receiving increasing attention from zoologists, especially it has been determined that, in at least some cases, the sexes are characterized by differences in the number or sizes of chromosomes, e.g., in one of the worms, two of the four sperms produced from a mother cell has five chromosomes while the other two have six. All of the eggs have six chromosomes. An egg fertilized by a sperm with five chromosomes produces a male individual, while fertilization by a sperm with six chromosomes results in a female individual. In plants, investigations have not advanced to any such extent but it is known that, in some cases, the two sexes are differentiated during the reduction of chromosomes (see CHROMOSOME), while in others the differentiation takes place at various stages in the life history. In both animals and plants, efforts have been made to control, artificially, the sex of offspring, chiefly by nutrition. If the number or size of the chromosomes should be the determining factor, no experiments in nutrition could affect the result, unless such experiments could affect the chromosomes. Consult Coulter, J. M., 'The Evolution of Sex in Plants'; Morgan, T. H., 'Heredity and Sex'; Walter, H. E., 'Genetics.'

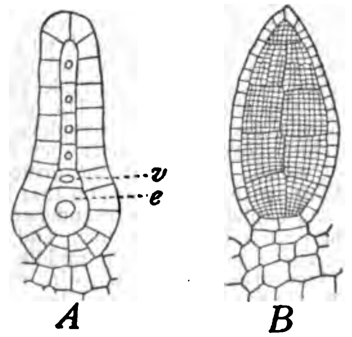

FIG. 3.—*Archegonium, A,* and *antheridium, B,* of a liverwort; *e,* egg; *v,* ventral canal cell.

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PLANTS, Structure of. The cell, the elementary organ of plants and animals, was first observed by the English micrographer, Robert Hooke (1667), who suggested the name "cell" because of its resemblance to the cell of a honeycomb. A few years later another English author, Nehemiah Grew, extended this observation and published the first work on plant-anatomy (1672), in which he described the minor structure of leaves, stems and roots, and introduced several anatomical terms still in use. Grew was soon followed by an Italian, Marcello Malpighi, the author of the illustrious work, 'Anatome Plantarum' (1675), and these three men are thus the founders of the science of plant morphology, as the study of plant structures is now called, the term anatomy being restricted to the study of plant tissues. Many years later Robert Brown (1833) detected the nucleus in the cell, and the German botanist Schleiden (1838) pointed out the general occurrence of this new body within the cells of plants and its importance to the cell-division. These discoveries soon led to the apprehension of the cell as being the elementary organ of plants, and when the occurrence of nucleus had been proved also in the cells of animals the German naturalist Schwann (1839) advanced the important doctrine that bodies of animals and plants consist of cells and the products of these.

While the nucleus had thus been detected and described to some extent, there still remained a closer examination to be made of the other parts of the cell-contact, which some of the earlier investigators had already observed and described as a soft, gritty matter, capable of motion in the cell. This cell-content was studied by Mohl (1846), who gave it the name protoplasm. The constituents of the cell were thus properly defined as the cell-wall, the protoplasm and the nucleus. Of these the protoplasm and the nucleus are the most essential parts, since the wall is not always developed, but is totally absent in numerous animal-cells and also in those of several plants among the lower *Algæ* and *Fungi,* at certain stages, for example. A completely developed plant-cell may for the most part be defined as a microscopical, closed vesicle consisting of a wall, and the contents, nucleus, protoplasm and cell-sap. The shape of the cell presents a vast number of forms, generally referred to only two types: the parenchymatic and the prosenchymatic. Of these the parenchymatic is either isodiametric or elongated, but with blunt ends and usually thin-walled, while the prosenchymatic is mostly elongated with pointed or sharp endings, and is more or less thick-walled. A third type of cell may be mentioned, the "hypha" of certain *Algæ* and *Fungi*, which is very thin, thread-like and composed of a single cell or many. There are plants consisting of one cell only, but most plants are composed of an enormous number, which together constitute the so-called "cellular tissues," parenchyma and prosenchyma, in respect to the shape of the cells of which they are composed. The function performed by these tissues is very different, and the classification as parenchyma and prosenchyma is thus not sufficient, since this only applies to the external shape of the cells. In accordance with both structure and function the following tissues are observable in the higher plants: Epidermis, the mechanical tissue, the conductive tissue and the fundamental tissue; the first and the last of these tissues being parenchymatic, the others prosenchymatic.

The minor structure of these various tissues may be described as follows:

Epidermis.— This is the outermost cell-covering of a plant-organ, such as the leaf, stem and root, and consists of at least one layer of cells. The outer cell-wall is often considerably thickened and invariably covered by a thin membrane, the so-called cuticle (*c* in Fig. 1) which is highly impermeable to water, and especially well developed in land-plants; in submerged water-plants the cuticle is, on the other hand, much reduced. The epidermal system of plants has a threefold significance: it protects the more delicate parts of the organs against mechanical injuries, pressure, etc.; it forms a protection against evaporation by being impermeable to water and water-vapor, and forms also a water-supplying system. These three functions are expressed by various development of the cells, which may be illustrated by a section of a leaf of aloe (Fig. 1) in which all three epidermal peculiarities are quite well developed. The thick cuticle and cuticular layers form an excellent protection against loss of moisture, while the thickening of the outer cell-wall and portion of the radial walls furnishes the mechanical support. Characteristic of epidermis, furthermore, is its covering of hairs, which present a number of forms and of which the majority are developed from the epidermis itself. Some of them consist only of a single cell, but usually they are composed of several. The hairs may be simple or branched and attain various forms from sharply pointed to globose, scale-like or star-shaped. The ordinary hairs contain only air, and when occurring as a dense covering of the plant-organ aid materially in the protection against loss of moisture, thus entering directly into the function of epidermis. Other hairs contain and secrete ethereal oils, the so-called glandular hairs, which may serve for attracting insects to carry the pollen, or if the secretion is of a sticky consistence, the function may be to keep off injurious, crawling insects, less adapted for aiding in cross-fecundation. Several hairs contain poisonous matters and cause great pain when touched, as, for instance, the hairs of the common nettle, but the physiological significance of such and other hair structures is not satisfactorily explained.

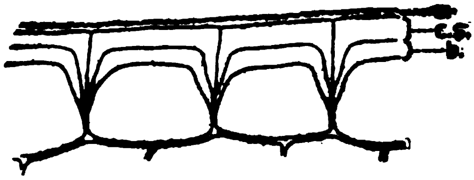

FIG. 1.— Epidermal cells of the leaf of aloe: *c*, the cuticle; *c. s.*, cuticular layers; *b*, cellulose.

A very simple structure is possessed by the root-hairs, which consist of only a single epidermis-cell, and of which the function is to absorb and conduct food substances in solution. A purely mechanical function is exhibited by the climbing-hairs — that is, hairs in the shape of hooks by which the weak stems of certain plants — for instance, hop, cleavers, etc.— are able to climb by attaching themselves to other plants.

Finally to be mentioned are the stomata. If the epidermis be able to regulate the evaporation, it is readily understood that this tissue must be compact and without intercellular spaces unless these be capable of closing and opening themselves under certain conditions. Such intercellular spaces occur in the epidermis and were by De Candolle named "stomata." Each stoma consists of two crescent-shaped cells, the guard-cells, which turn their concave faces against each other, thus forming an intercellular space leading into a wide cavity, the so-called air-chamber (as in Fig. 2). Adjoining the guard-cells are usually two or more epidermis-cells of a shape somewhat different from the others, and these have been called the subsidiary cells; their number and manner of arrangement is often very variable in several orders of the phanerogams. The guard-cells are, as a rule, the only cells of epidermis which contain chlorophyll and starch; they have the power of closing or opening the orifice of the intercellular space, a phenomenon that has been studied and explained by Schwendener. When moist these cells become swollen, and, as they lengthen, curve outward in the middle so as to leave a free opening. An opposite movement takes place when they become dry: they are then shortened and straightened with their inner faces applied to each other, closing the orifice. Stomata occur as a rule on all green plant-organs, stems and leaves, but lack in those that are constantly under water, and they are totally absent in the thallophytes. The location of the stomata varies somewhat, but they are more numerous on the lower face of the leaves than on the upper. Their position offers a number of variations and is sometimes dependent upon the nature of the surroundings, especially of the climate, the dryness of the air,

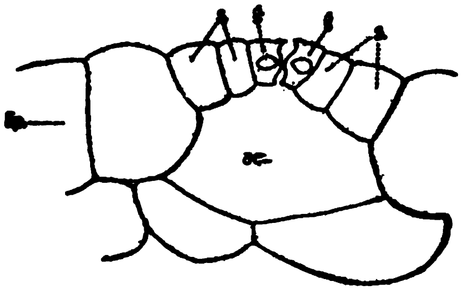

FIG. 2.— Cross-section of a stoma from the leaf of *Commelina*; *ac*, the air-chamber; *g*, guard-cells; *s*, subsidiary cells.

etc. The guard-cells may be free, reaching above the surrounding epidermis, or they may be sunk below this. A very peculiar arrangement is noticeable in *Nerium*, where the stomata are located, several together, in depressions of the leaf-surface. A modification of stomata are the so-called water-pores, exhibiting a like structure, but somewhat larger than these and unable to open or close themselves. They are mostly located on the margins of leaves near the ends of the nerves.

The Cork.— While the epidermis is seldom of any long duration in plant-organs which persist for more than one season, another covering becomes necessary and is represented by the so-called cork. This tissue may be developed by the epidermis itself, but in most instances it originates in the parenchymatic layers underneath the epidermis, or sometimes much deeper, in the innermost portion of the cortex, for instance. The cork is able to continue its growth, following the increase in thickness of the stem, and consists of several strata of quadratic or rectangular cells, arranged in compact rows, vertical on the surface of the plant-organ.

The Mechanical Tissue.— The best-known elements of this tissue are the so-called «stereome-cells,» which are thick-walled, very long prosenchymatic cells, of which the walls have narrow pores and consist of cellulose. The stereome-cells are mostly arranged in strands and located in such portions of leaves or stems as are the most exposed to injury. The cells are very flexible, and the arrangement of the layers is remarkably well fitted for rendering the plant-organ the greatest possible support by means of the smallest quantity of material, as demonstrated by Schwendener. Besides this function the mechanical tissue is also observed to form protective layers around the mestome-bundles, especially near the leptome-elements.

Another thick-walled but parenchymatic cell-form is the so-called sclerotic, occurring in the cocoanut, walnut, etc.

The Conductive Tissue.— This tissue is represented by the so-called «mestome-bundles» or «vascular bundles» of earlier authors, which traverse the plant-organs mostly in a longitudinal direction; they constitute a part of the nerves in leaves and of the wood in trees. Their composition is often very complicated, especially in stems and roots, where they are often associated with some of the other tissues, from which they are not always readily distinguished. At present «mestome,» as proposed by Schwendener, comprises only two elements, «leptome» and «hadrome,» of which the former conducts albuminous matters and contains the sieve-tubes and the medullary ray-parenchyma. The hadrome contains the vessels and the woody parenchyma and conducts the water. These terms, leptome and hadrome, are not identical with the «phoem» and «xylem» formerly suggested by Nageli, since this author included the mechanical tissue, the stereome, which is often developed in almost immediate connection with the true conductive tissue.

Mestome-bundles, containing leptome and hadrome, are observable in all the higher plants: vascular cryptogams and phanerogams, but are not developed in any of the thallophytes (*Fungi* and *Algæ*) or in the mosses.

The Fundamental Tissue.— This tissue comprises all the other tissues of the plant not referable to the epidermis, the mechanical or the conductive tissue, and is as a rule composed of thin-walled, parenchymatic cells with distinct intercellular spaces. Its function is principally to prepare and store nutritive matters, hence the chlorophyll, the starch and similar matters are contained in this tissue. Several types of fundamental tissue have been distinguished in the various plant-organs, such as the cortex in stems and roots; the pith in stems, but only occasionally in roots; the mesophyll with the palisade- and pneumatic-tissue in leaves; and finally the parenchymatic sheaths, which often surround the mestome-bundles as the endodermis, the mestome-sheath, etc.

The Root Structure.— The fact that the root is only slightly susceptible of modification in respect to its external structure is especially expressed by the great uniformity that prevails in its internal structure. Roots, however, are not always quite as uniformly developed as generally described, but very few botanists have paid much attention to their structural peculiarities. Some types of roots have been suggested — for instance, «nutritive,» «attachment,» «contractile» and «storage» — all of which possess a somewhat modified structure corresponding to their functions. But common to all roots are the following tissues: Epidermis, cortex, pericambium and the conductive tissue.

The Structure of the Stem.— The minor structure of the stem of the above- and underground differs materially from that described as characteristic of normal roots, even if the tissues themselves are much the same. There is an epidermis, a cortex, a mechanical- and conductive-tissue besides a pith, but no pericambium. The stem, however, exhibits a much larger plasticity than the root, and the numerous modifications that occur in respect to the mere external structure are usually accompanied by a corresponding variation in its interior. Marked distinctions are noticeable in stems when we compare the herbaceous with the woody, the annual with the perennial, the terrestrial with the aquatic, and the aerial with the subterranean,— distinctions that have been very extensively studied and have rendered it possible to identify fragments of such stems merely by the aid of the microscope.

When compared with the root, the presence of a pith is characteristic of the stem, while on the other hand a pericambium is observable only in roots. The minor structure of the stem is thus very variable.

The Structure of the Leaf.— The manifold variation exhibited by leaves corresponds also with certain modifications of the internal structure, but to a much less extent than observable in stems. The various functions performed by the leaves do not require such great internal modification as is necessary to the stem, even if the leaves exhibit a metamorphosis of no small importance. The stem-leaves and the floral leaves naturally show conspicuous anatomical distinctions, and the fleshy leaves of bulbs are of course very different in structure from the thin, scale-like leaves of tubers and stolons. However, the principal structure, such as is exhibited by the relative development and arrangement of the main tissues, for instance the mesophyll (the chlorohyll-bearing parenchyma including the palisade- and the penumatic-tissue), the stereome and the conductive tissue, is not very variable in leaves when we consider the enormous variation in the shape and size of their outline. In the leaves the epidermis is perhaps the tissue that is subject to the most conspicuous modification, which is especially noticeable in the development of the cells when examined on both surfaces of the leaf, above and between the nerves. The various arrangements of the stomata often cause a modification of the surrounding strata, which is less pronounced in the stems. Thus the epidermis, when examined superficially, exhibits several distinct forms of cells, rectangular, polyhedric, or with the outline very prominently modulate. The covering with hairs is especially characteristic of leaves, and several types of these may be found to occur on the same leaf. The cuticle is usually very distinct, and renders by its various consistence the most essential protection to the leaf while performing its functions. Besides the epidermis, corky layers may be developed, at least locally, in leaves which persist for several seasons; for instance, the evergreen, in which the outer cell-wall of epidermis often becomes very considerably thickened.

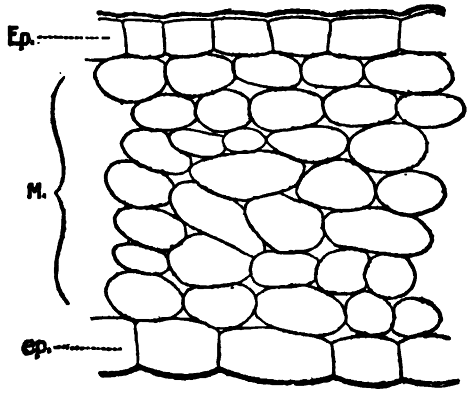

Fig. 3.— Cross-section of the leaf of *Obolaria: Ep*, epidermis of upper surface; *ep*, epidermis of the lower; *M*, the mesophyll.

The mesophyll is generally differentiated as a palisade- and a pneumatic-tissue, the former located on the upper face of the leaf, just beneath the epidermis, while the latter occupies the lower portion. In some leaves the mesophyll is not differentiated into these two tissues, but only as a homogeneous (Fig. 3) tissue; such leaves are called «isolateral» in contradistinction to the others, the «bifacial.» Otherwise the mesophyll possesses the same forms of reservoirs, ducts and lacumes as are characteristic of the cortex.

The leaf-structure thus possesses less variation than that of the stem, if we compare the relative development and the arrangement of the tissues, especially of the mesophyll, the stereome and the mestome. The main variation seems to lie in the epidermis, and becomes especially noticeable in the comparison of leaves of plants that grow under diverse conditions — of terrestrial and aquatic plants, for instance. Among the former the desert-plants are known to possess highly complicated structures, which naturally are expressed by the epidermis and the mesophyll rather than by the other elements. But considered as a whole, the leaves show less modification of the inner tissues than the stem, and when some prominent variations are found to occur in leaves these are generally observable also in the stems of the same plants. See PLANTS, VASCULAR ANATOMY OF; BOTANY.

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PLANTS, Vascular Anatomy of. Even in the earliest days of the microscope, the vascular structures of plants were objects of interest and a large proportion of the figures in Nehemiah Grew's 'The Anatomy of Plants,' published in 1682, deal with the vascular system. During the following century there was no advance in microscopic work and even the splendid beginnings made by Robert Hooke, Nehemiah Grew and others seem to have been forgotten; but with the beginning of the 19th century there was a vigorous resumption of microscopic work, accompanied by great improvements in the microscope, so that microscopes magnifying 500 diameters were common before the first quarter of the century had passed. The vascular structures received their full share of attention and by the middle of the century the various types of stems and bundles were thoroughly studied and the illustrations were even better than those of the present day. A definition of *vascular system* would be rather difficult to formulate. In the early development of the embryo, three regions are distinguishable, the dermatogen, which gives rise to the epidermis, the periblem, which produces cortex, and the plerome, which produces the vascular system. (See EMBRYOLOGY OF PLANTS). According to this embryological scheme, not only vascular structures but also the pith and some other comparatively soft tissues would be included. There is no doubt that the essential structures of the vascular system are the *xylem* (wood) and the *phloem* (often called bast). In a general way, it may be said that crude sap arises in the xylem, while elaborated material comes down in the phloem or is stored there. Practically all who have studied the ascent of sap agree that the upward movement is in the xylem. While the structure of the xylem and phloem became well known before the middle of the 19th century, investigations were limited to descriptions of vascular bundles in various plants, there being no attempt to use the results in any evolutionary scheme. Of course, it must be remembered that at this time most biologists still believed in the fixity of species. Darwin's 'Origin of Species' did not appear until 1859, but even after this time it was nearly 50 years before vascular anatomy was recognized as a valuable aid in tracing relationships. This new aid is of particular value because many of the fossil plants are represented only by their stems and often by nothing but fragments of these. In modern anatomy a large number of terms, some of them new, became necessary. Four types of stems, as seen in cross section, are commonly recognized. They are the *protostele, amphiphloic siphonostele, polystele* and *ectophloic siphonstele.* While the names are rather formidable, a few diagrams will make their meaning clear (Fig. 1). The most primitive type is the protostele (*A*).

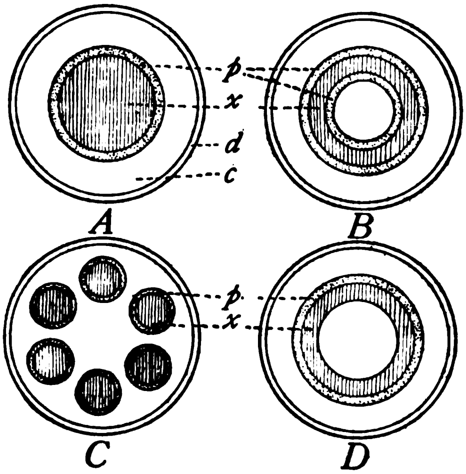

Fig. 1.— Diagrams of types of vascular cylinders (steles) as seen in transverse section. *A*, protostele; *B*, amphiphloic siphonostele; *C*, polystele; *D*, ectophloic siphonostele. In all the diagrams the xylem is hatched and the phloem dotted; the narrow outer zone is the epidermis and the zone inside it, the cortex. These features are lettered in *A*, *d* being epidermis; *c*, cortex; *p*, phloem; *x*, xylem.

The name indicates that it is the first type of cylinder. It is characterized by a solid central mass of xylem surrounded by phloem. This type is found in all roots and in the stems of most lycopods and some ferns. It is very rare in the flowering plants. The amphiphloic siphonostele (*B*) is so named because the stele has a pith in the centre and has phloem on both sides of the xylem. The English botanists call this form the *solenostele.* This type is quite frequent in ferns, but is occasionally met in higher plants. The polystele (*C*), as the name indicates, consists of several steles, each stele having the structure of a protostele. Many do not regard this as a separate type, since it results from the splitting of an amphiphloic siphonostele into several steles. Most ferns show this type, but there are examples among the flowering plants. The ectophloic siphonostele (*D*) has a pith and has phloem only on the outside of the xylem. Some ferns show this type, but it is almost universal in the flowering plants. There is little difference of opinion as to the evolutionary sequence of these steles. The protostele is most abundantly represented in Paleozoic fossils and the ectophloic siphonostele is more abundant in the living flowering plants. In sporelings and seedlings of most vascular plants, the vascular cylinder is first outlined as a protostele, remaining in that condition in the forms mentioned above, but in others becoming differentiated into the higher types in the subsequent history of the individual. Many botanists see in this behavior an excellent example of recapitulation. See PLANTS, RECAPITULATION IN.

After the cells which are to constitute a bundle of xylem and phlœm have been formed, there is first a differentiation into xylem and phlœm regions. These two regions are called the *primary xylem* and *primary phlœm.* In the primary xylem, the walls of some of the cells begin to thicken earlier than in others. As the cell walls thicken and harden, the growth in diameter of such cells is checked; and since these cells are not scattered, but form a group, they can be recognized, in transverse section, by their smaller diameter, the surrounding cells having continued their growth for a while before any thickening occurred. The thickening of the first cells takes place during a period of rapid elongation which causes the thickening to take the form of spirals and rings. This first xylem is called *protoxylem* and the rest of the primary xylem is called *metaxylem.* The protoxylem is characterized, generally, by the smaller diameter of its cells, but almost always by the spiral and annular thickenings. The metaxylem may have pits or reticular markings, but no spirals or rings. The position of the protoxylem in the primary xylem is of great importance. There are three positions (Fig. 2). The protoxylem may be at the outside of the primary xylem, next to the phloem (Fig. 2*A*). In this case the vascular bundle is said to be *exarch.* This type is found in all roots, in the stems of lycopods and in a few of the higher plants. When the protoxylem group is surrounded by the rest of the primary wood — which is called metaxylem — the bundle is said to be *mesarch* (Fig. 2, *B*). This condi-

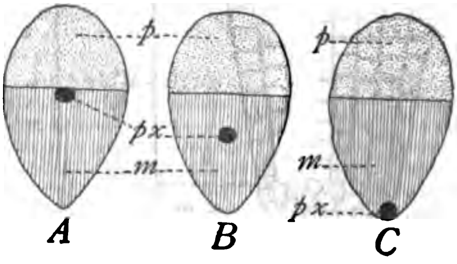

Fig. 2.— Diagrams showing three types of primary bundles. The primary phloem is dotted, the primary wood is hatched, and the position of the protoxylem is indicated by the solid black dot. All the primary xylem, except the protoxylem. *A*, exarch arrangement; *B*, mesarch; *C*, endarch.

tion is characteristic of ferns, but is found in the adult stems of some of the Paleozoic Gymnosperms and in seedling stems of some living Gymnosperms. It is also found, as a vestige, in the cone stems and leaf veins of some living Gymnosperms. However, it is so characteristic of ferns, that it is regarded as a lingering effect of a fern ancestry when it is found in Gymnosperms. The third type is the endarch bundle. It is found only in siphonosteles and the protoxylem is next the pith (Fig. 2, *C*). This is the most advanced type and is characteristic of the flowering plants, although a few ferns have reached this level. The exarch condition is regarded as the most primitive because it has its most abundant representation in Paleozoic fossils and also because it is found in plants which, for other reasons, are regarded as primitive. The endarch condition is regarded as the most advanced, because it is rare in ferns and ancient seed plants, but is almost universal in living seed plants. The mesarch character is plainly intermediate.

Secondary xylem and secondary phloem are formed by a layer of embryonic cells which arise on the inner border of the primary phloem. These cells are called the ***cambium*** and by their division they add to the xylem and phloem, so that the primary xylem and primary phloem become separated by zones of secondary wood and secondary phloem (Fig. 3). The secondary structures are easily recognized from the fact that they are arranged in definite rows, while the cells of the primary xylem and phloem are more or less irregular in their arrangement. The structure of an ordinary dicotyl stem, like that of a geranium, or monocotyl stem, like that of corn, is very complicated (Fig. 4). The dicotyl stem shown in the diagram has an endarch siphonostele. At first, it had five primary bundles, each with its primary xylem and primary phloem; but, later each bundle developed secondary xylem and secondary phloem, so that each of the five bundles assumed the structure shown in Fig. 3. Then the cambium of the five bundles became extended, so as to bridge the gaps between the bundles, forming a complete zone of cambium. This new cambium forming secondary xylem and secondary phloem, nearly filling in the gaps between the five original bundles, makes the woody cylinder almost complete. However, there are still left some thin plates of tissue between the solid woody portions. These plates are called rays. Some of the wider rays are breaks in the cylinder just above the points where the vascular systems of leaves unite with the cylinder. Such rays are called leaf gaps. Some botanists attach such extreme importance to the leaf gap that they divide all vascular plants into two groups, one (Pteropsida), characterized by the presence of the leaf gap, and the other (Lycopsida), lacking the gap. These botanists insist that the Gymnosperms, all of which have leaf gaps, could not have been derived from the lycopods, which have no leaf gaps, but must have come from the ferns, which are a leaf gap assemblage. All agree that the zone of wood surrounding a pith, as shown in Fig. 4, *A*, is a more primitive arrangement than the scattered bundles shown in *B*, of the same figure. The zone of wood surrounding a pith is characteristic of the Gymnosperms and Dicotyls, but some Dicotyls show the scattered arrangement; the scattered bundles are characteristic of the Monocotyls, but some Monocotyls have a distinct zone of wood surrounding a pith. This is just what should be expected, if the Monocotyl line has been derived from the Dicotyl, as practically all botanists now believe. A study of the bundle arrangement in the Monocotyl seedling and even the arrangement in the adult stem confirm this view. The structure of the individual bundles of Dicotyls and Monocotyls is different. In Dicotyls the xylem and phloem lie side by side, with the cambium forming a straight line between them, so that the bundle is *collateral*. In many of the Monocotyls the xylem has grown up around the phloem, so as to enclose it, forming an ***amphivasal*** bundle. The amphivasal condition is so obviously derived from the collateral, that it is a strong argument in favor of the claim that the Monocotyls constitute a branch from the Dicotyls. Another difference is that the Dicotyls have a cambium between the xylem and phloem and so have a continuous growth; while the latter have no cambium and, therefore, no secondary growth. Bundles with a cambium are said to be

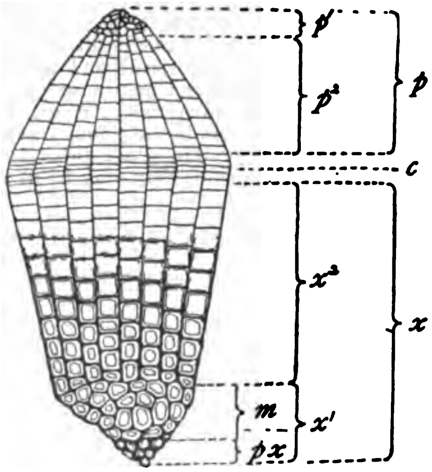

FIG. 3.—Diagrammatic sketch of a vascular bundle: p, phloem; c cambium; x, xylem, p', primary phloem; p^2 secondary phloem, x' primary xylem consisting of metaxylem, m, and protoxylem, px.

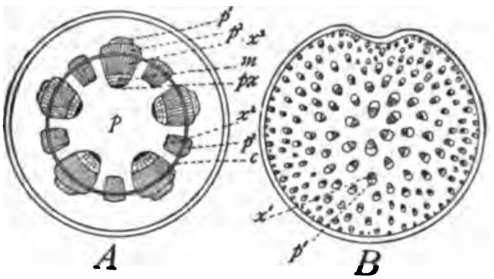

FIG. 4.—Diagrams of cross-sections of stems. *A*, typical dicotyl stem, showing p, pith, surrounded by a ring of vascular bundles; p', primary phloem; p^2, secondary phloem; m, metaxylem; px', protoxylem; x^2, secondary xylem; c, cambium. *B*, monocotyl stem showing scattered bundles; x, primary xylem; p', primary phloem.

open; those without are said to be closed. Monocotyls have lost the cambium between the xylem and phloem. However, some tree-like Monocotyls, like the Yucca, Aloe and Dracena (Dragon Tree), have an embryonic region at the outer part of the woody region, which produces a succession of new bundles of the closed type, and thus the trunk may reach a diameter of several feet. Such cases are rare and practically confined to the tropics and subtropics. Practically all shrubs and trees owe their increase in diameter to the zone of the cambium between the xylem and phloem. In temperate regions, the cambium is very active in the spring, becomes less active as summer advances, becomes sluggish in autumn and in winter its cells are dormant, not dividing at all. With the return of spring, the cambium renews its activity. The first cells formed in the spring are the largest of the year and the size gradually decreases as the season advances, the last cells formed in the autumn being comparatively small. This alternation of large and small cells is the cause of the annual rings, which are easily seen by the naked eye and which mark, with reasonable accuracy, the age of the plant, since a new ring is formed each year (Fig. 5).

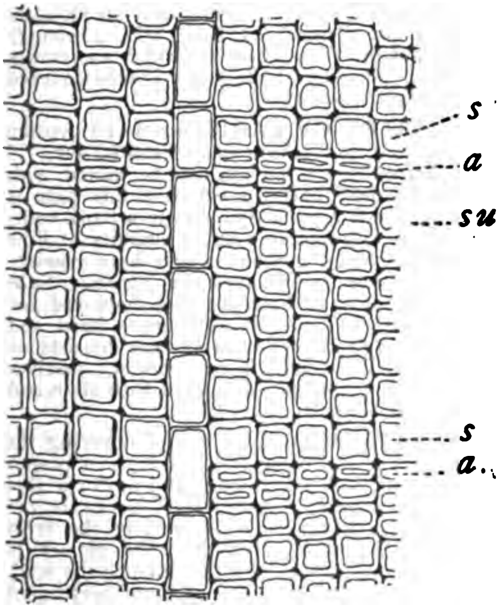

FIG. 5.— Transverse section of a piece of Pine wood showing a year's growth with part of the growth of the preceding and succeeding years. *s,* large cells formed in the spring; *su,* smaller cells formed in summer; *a,* smallest cells, formed in autumn. To the naked eye, the zones marked *a* appear as a sharp line, or "ring."

If a dry summer is followed by a warm, rainy autumn, a second ring may be formed. Conditions which will cause an appletree or peach tree to blossom in the autumn will also produce a second ring of wood. In the tropics, the alternation of rainy seasons and dry seasons acts in the same way as the warm and cold seasons of the temperate zone and results in the formation of growth rings. In a few tropical places where the temperature and rainfall are nearly constant throughout the entire year, woody stems of considerable size are formed without any appearance of growth rings. Investigations upon the vascular system are being prosecuted with great vigor and have already shed much light upon the evolution and relationships of plants and it is possible that the results may, eventually, be of considerable economic importance. Consult Coulter, J. M., and Chamberlain, C. J., 'Morphology of Gymnosperms'; Jeffrey, E. C., two chapters in 'Seed Plants,' by Coulter, J. M., and Chamberlain, C. J.; Jeffrey, 'Anatomy of Woody Plants.'

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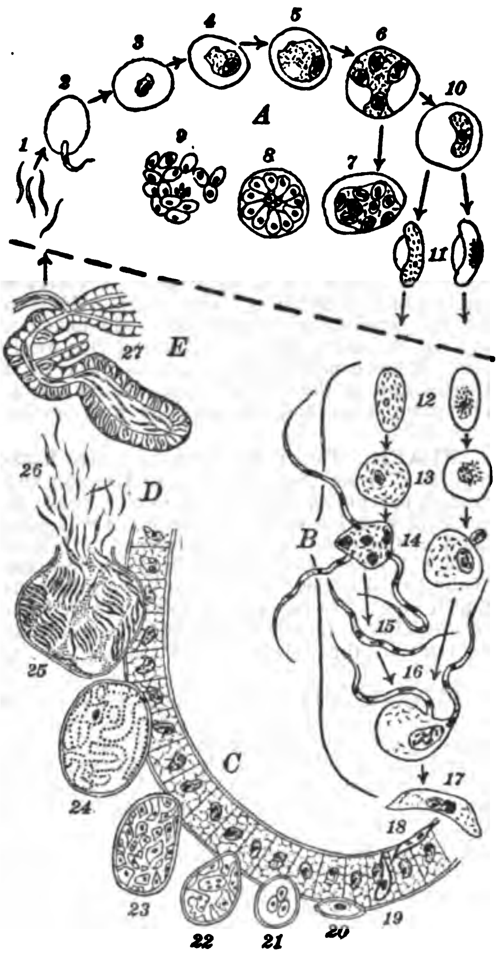
PLAQUEMINE, plăk-mēn', La., town, parish-seat of Iberville Parish, on the Mississippi River, and on the Texas and Pacific Railroad, about 15 miles south of Baton Rouge. It is in a productive agricultural region, and is the trade centre for a large part of Iberville and adjoining parishes. The chief industries are saw and shingle mills, stave and heading, and oar factories, sugar, cotton and rice products. It has considerable trade in manufactured articles and in the raw products of the farms. The town owns and operates the waterworks. Pop. 4,955.

PLARR, Victor Gustave, English librarian: b. 21 June 1863. He was of German and English parentage, removed from Strassburg to Scotland with his parents in 1870 and was educated at Oxford. He was librarian of King's College, London, 1890–97, and has been librarian of the Royal College of Surgeons from the last-named year. He has edited 'Men and Women of the Time,' 14th and 15th editions, and has written 'In the Dorian Mood' verse (1896), etc.

PLASMA, (1) *in mineralogy,* a leek-green silicious mineral, found in angular pieces associated with chalcedony. It is feebly translucent, and has a somewhat oily lustre. It is somewhat rare and was wrought into engraved ornaments by the Romans to a considerable extent. (2) *In biology,* the liquid part of nutritive animal fluids, such as blood, lymph or milk as distinguished from the organized solids contained in them, as for instance the corpuscles of the blood.

PLASMODIUM, a genus of sporozoan protozoa that contains the malarial organisms. The genus belongs to the order *Hæmosporidia* which contains highly specialized parasites adapted for life in the blood stream. There are included three parasites of human malaria and also a species which produces avian malaria. The young Plasmodium (see Fig. *A*) which is active and amoeboid occurs in the red blood corpuscles and after a period of growth, during which it attains rapidly the size of the corpuscle, the organism divides into numerous spores (*merozoites*) which scatter and attack new blood cells. The process of schizogony just described is repeated until the infection has become general. When a corpuscle breaks up and the merozoites are scattered a central residual mass of protoplasm loaded with black pigment (*melanin*) is dispersed in the blood plasma.

At times the merozoites in the corpuscles develop into two new types, the gametes, one of which is finely granular and opaque whereas the other is hyaline. These do not undergo further change until the blood is withdrawn into the stomach of a mosquito, though the same changes follow its experimental removal to a culture tube. In the mosquito's stomach (see Fig. *B*) the motile microgametes are formed and one such fuses with a non-motile macrogamete after the latter has extruded a portion of its nuclear substance. There is formed by the union a motile ookinet which penetrates the stomach wall of the mosquito (see Fig. *C*), encysts and undergoes multiple division to form sporoblasts within which arise also by division sporozoites. The latter are very minute. Set free by rupture of the cystwall they wander to the proboscis and enter the salivary glands (see Fig. *E*) whence they are injected into a new human host when the mosquito bites. They attack the red cells at once and the life cycle begins anew.



Life cycle of *Plasmodium falciparum*. *A*, Asexual cycle in human blood; 1, sporozoites injected by mosquito bite, 2-9 schizogony and reinfection of corpuscles, 10-11 origin of gametes. *B-E*, Sexual cycle in mosquito; *B*, in stomach, 12-17 growth and fusion of gametes; *C*, sporogony in wall of intestine, 18-25 formation of sporoblasts and of sporozoites in cysts; *D*, sporozoites in body cavity; *E*, sporozoites penetrating salivary gland and proboscis.
The dotted line across the figure separates stages in man (above) from those in mosquito (below).

Laveran in 1880 was the first to attach significance to the structures found in red blood cells in cases of malaria though the malarial organism had actually been seen and figured in 1843. Manson set forth distinctly in 1896 the part of the mosquito in transmitting the disease and a year later Ross followed in detail for the first time the fate of the parasites in the body of the mosquito. Malarial parasites have been cultivated *in vitro* by Bass and Johns.

The three species parasitic in man give rise to different and generally recognized types of malaria. *Plasmodium malariæ,* which extends farthest north and is not found in the tropics, is the cause of quartan fever. *Plasmodium vivax* gives rise to the tertian fever; it is widely distributed and not very dangerous. *Plasmodium falciparum,* the smallest of all three, produces the dangerous fevers known as the pernicious, tropical, quotidian or estivo-autumnal type; this type is epidemic only in the tropics and subtropics. Other varieties have been described though their independent character is not fully recognized.

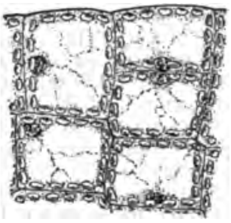
PLASSEY, plăs'sē, India, a village on the Bhagirathi River, 96 miles north of Calcutta, celebrated in the history of India for the great victory gained by Clive over Suraj ud Dowlah, subahdar of Bengal, 23 June 1757, a victory which laid the foundation of British supremacy in India. The site of the battle is now covered by the river. See INDIA.

PLASTER OF PARIS, powdered gypsum as prepared for taking casts, molds, etc. If one part of powdered gypsum be mixed with two and a half parts of water, a thin pulp is formed, which after a time sets to a hard, compact mass. By adding a small quantity of lime to the moistened gypsum a very hard marble-like substance is obtained on setting. Substances other than lime are also employed for the purpose of rendering the mass hard and very compact; thus Parian cement consists of plaster of Paris mixed with borax; marble-cement is the same plaster mixed with alum and soda. See GYPSUM.

PLASTERING is the art of covering the surface of a wall or ceiling with lime or plaster in order to give it a smooth and uniform surface, and generally in interiors to fit it for painting or decoration. Technically the term plastering is used only when the plaster is spread over a screen of laths fixed to the wall. In modern usage this lath may be of perforated sheet metal, or a heavy paper board, called plaster board, may be substituted for the wooden laths. The chief preparations used by plasterers are known as *coarse stuff, fine stuff, plasterer's putty,* and *gauged stuff.* The first of these is composed of sand and lime, mixed with long ox hair; the second is slaked lime, usually without hair; the third is not unlike the second; and gauged stuff is a mixture of plasterers' putty and plaster of Paris. Three kinds of plastering are distinguished, namely, one-coat (lath and lay), two-coat (lath, lay and set), and three-coat (lath, lay, float and set). In one-coat work a layer of coarse stuff is spread over the laths and pressed well into the spaces so as to form a *key* to hold the coat in place. When a second coat is to be applied, the first is not smoothed, but roughened with a birch-broom so as to retain the second one in place. The second coat consists of fine stuff, putty or gauged stuff. In plastering the interior of houses a first coat is laid on of coarse stuff, the process being known as *pricking-up*. The face of the first coat, which should be of considerable thickness, is troweled or indented diagonally with the point of a lath to form a key for the finishing coats. The second coat is applied to this when it is thoroughly dried. It consists of fine stuff, and is rubbed in with a flat board so as thoroughly to fill the indentations and cover the unequal surface of the first coat with a smooth and even one. In plastering walls great care must be taken to have the surface perfectly vertical. This second coat is called the floated coat, because wooden boards, known as floats, are used in rendering the surface plane. Before drying this coat is scraped with a birch-broom to form a key for the next. The setting coat is applied to the second after it has become perfectly dry. If the wall is to be papered this coat is of fine stuff. (See BUILDING; GYPSUM; LATHS). Consult Eckel, E. C., ‘Cements, Limes and Plasters’ (New York 1905); Hodgson, F. T., ‘Mortars, Plasters, Stuccos, Artificial Marbles, Concretes, Portland Cements and Compositions’ (Chicago 1914); Millar, ‘Plastering’ (London 1892); Richey, H. G., ‘Building Mechanics’ Ready Reference: Cement Workers’ and Plasterers’ Edition’ (New York 1908).

PLASTERS, preparations for local application to the surface of the body, kept in place by any convenient wrapping of cotton, linen, silk, etc., or merely of paper and frequently with the aid of some adhesive substance. Plasters may be intended simply to give protection, support or warmth, as in the case of wounds, bruises or local weakness, or they may be actively medicinal. In most of the recognized medicinal plasters the adhesive property is due to the combination of oxide of lead with fatty acids, though india-rubber is also used. Olive-oil and litharge are used in the compound which most frequently forms their base. The 13 plasters of the United States Pharmacopœia are ammonia and mercury, arnica, belladonna, cantharides, capsicum, iron, isinglass, lead, mercury, opium, pitch, resin and soap. The numerous unofficial plasters are various in composition and in specific purpose and efficacy. The porous plaster made to stick very firmly to the skin has been popular. Plasters in the form of blisters are also largely used. See BLISTER.

PLASTID. A plastid may be defined as a differentiated portion of the plant protoplasm which is not formed *de novo,* but arises from the division of a pre-existing plastid. Plastids are denser than the surrounding protoplasm and the interior is denser than the surface. There is no surrounding membrane. The shape is generally spherical or oval (Fig. 1), but many plants have very striking plastids, as in case of the *alga,* Spirogyra (Fig. 2). When plastids are colorless, they are called *leucoplasts,* or *leucoplastids;* when colored, they are called *chromatophores.* When chromatophores are green, they are called *chloroplasts;* when they have any color other than green, they are *chromoplasts.* However, most botanists do not use so many names, but call all the colorless plastids leucoplasts and all the colored ones chromatophores. In all cases, the ground substance of the plastid is colorless, but it contains droplets of an oily substance which is green, yellow, orange, red or brown, as the case may be. Plastids near the surface are likely to develop chlorophyll, a green oily substance of the utmost importance in plant life; while plastids more deeply placed are likely to remain as colorless leucoplasts whose principal function is to produce starch. However, a leucoplast may become a chloroplast, as when potatoes are exposed to the light and become green; and they again become leucoplasts when the potatoes are kept in the dark. Chlorophyll-bearing plastids usually contain also some very small grains of starch. Such starch grains are the first visible products of assimilation. Reserve starch, like the large starch grains of the potato, are formed inside the leucoplast and become so large that the leucoplast is stretched until it is only a very thin membrane surrounding the conspicuous starch grain. Botanists are not entirely agreed as to whether the plastid may originate *de novo* or not. The weight of authority is on the side of those who claim that the plastid is a permanent organ which arises only by the division of a previous plastid, as already indicated in our definition. That plastids divide and that an unbroken series can be traced throughout the greater part of the life history no one disputes; but in some phases of the life history, the most critical methods give no convincing demonstration of the presence of a plastid. In recent years, peculiar structures, called *mitochondria,* many of which resemble various forms of bacteria, have been claimed to develop into plastids (Fig. 3). This subject is still under vigorous investigation. Consult Mayer, A., ‘Untersuchungen über die Stärkekörner’; Schimper, A. F. W., ‘Uber die Entwickelung der Chlorophyllkörner und Farbkörper’ (*Botanische Zeitung,* Vol. XLI, 1883, p. 105); Cavers, F., “Chondrio-



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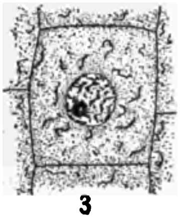

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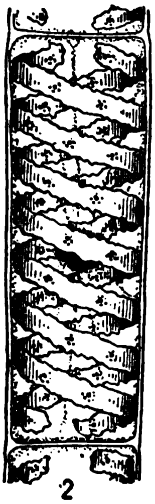

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FIG. 1.— Sectional view of four cells of a fern prothallium, showing numerous small plastids.

FIG. 2.— A cell of the pond scum, Spirogyra, showing two spiral plastids, or chromatophores.

FIG. 3.— Sectional view of a cell of an onion root tip showing thread-like mitochondira. All highly magnified.

somes and Their Significance» (in 'New Phytologist,' Vol. XXXI, p. 170, 1914).

CHARLES J. CHAMBERLAIN.

PLATA, Rio de la, rē'ō dā lä plä'tä (silver river), a great estuary of South America, lying between Uruguay and Argentina and formed by the junction of the Paraná and the Uruguay rivers (qq.v.). With these rivers it may be considered the second great river system of South America which drains the so-called La Plata states, namely, Argentina, Uruguay, Paraguay, southeastern Bolivia and southern Brazil. But the Plata itself is merely the estuary of this system and it is impossible to mark the point where it empties into the ocean, as the «river» is 170 miles wide between Cape San Antonio and Cape Santa Maria. The volume of the river is great, in spite of its shallowness, and its current is perceptible 150 miles out to sea. The broadest river-mouth of the world, the Plata measures 25 miles across at Buenos Aires and more than 60 at Montevideo, where the only harbor of the whole basin is situated. At both Buenos Aires and the port of La Plata immense piers or breakwaters are built out far into the water. The entry from the ocean is dangerous and is guarded by lighthouses and lightships. The course of the La Plata system was explored by Day in 1853 and by Page 1853–56.

PLATÆA, plă-tē'ạ, ancient city of Bœotia in Greece, on the frontier of Attica, beneath Mount Cithæron and south of the Asopus River, at the head of the Gulf of Corinth. The famous temples of Hera and of Athena Areia with one of Phidias' colossal statues and paintings by Polygnotus were situated here. Its inhabitants were probably of Ionian stock. In 519 they made a treaty of alliance with Athens and at Marathon 1,000 Platæans shared in the victory. Their city was burned by the Persians in 479 and in September of the same year the Persian army was defeated here by the Platæans, Athenians and Spartans in a bloody battle, in which Mardonius, leader of the forces, left for the conquest of Greece after Salamis, took the offensive after the armies had been face to face for a fortnight and was killed with almost his entire army. The Platæans were highly honored by their allies for their part in this great battle and their independence was guaranteed by all the Greek states. But in the Peloponnesian War Platæa sided with Athens and was nearly betrayed (431) by a body of Thebans who attempted to destroy the city. In 429 the Spartan army of Archidamus attacked the city, from which all the non-combatants save 110 women had been sent to Athens. The 480 who remained (80 Athenians) withstood all assaults, so that the Spartans had to be satisfied with a thorough blockade, in the second year of which the city was taken and its defenders killed, except a gallant party of 212 which had cut its way through the Spartan lines. The city was rebuilt and reoccupied by its people in 387, only to be destroyed again in 372 by the Thebans. It was again restored after the battle of Chæronea. A portion of the ancient city wall is still extant. Consult files of the *American Journal of Archæology.*

PLATE ARMOR. In general it may be said that at first all plate armor used was for reinforcing mail or other armor. The full panoply (cap-à-pied) was in use by the middle of the 15th century. The early period produced the finest pieces; the 16th century showed commencement of decline as to protective purposes. Then fire-arms caused the disuse of one piece after the other as affording too little protection. By the 18th century armor had become a ceremonial gear and was valued according to its metalworkers' and goldsmiths' decorative features. For historic purposes perhaps Ashdown's period division is as well suited as any, and is used in this description.

Studded and Splinted Period (1335–60).—This is a transition era in which «reinforced» chain-mail (see CHAIN-ARMOR) came into vogue. The bascinet (headpiece) was of plate with visor attached (see HELMETS), and in some cases with a neck-plate riveted to the headpiece. Demi-brassarts were used to protect the upper arm. A plate vambrace or demi-vambrace was sometimes worn over the hauberk (see HAUBERK) to add to the protection of the arm. Grevières or jambarts for the legs occur, but they were more often of splints than plate. Sollerets (see FOOT ARMOR) were in use but rarely and covered only part of the upper half of the foot. The shield was, when carried, of «heater» shape. (See SHIELDS). Roundels sometimes protect the armpits. Several effigies of the period show laminated epaulières (shoulder pieces), and reinforced coudières (elbow protectors), also demi-grevières of plate.

The Camail and Jupon Period (1360–1410).—The sleeveless cloth jupon (surcoat) was worn over a swelling breastplate, under which was the hauberk. The bascinet was tall and conical with visor (*snout-faced* visors belong to this period) and attached to the camail; the Italian barbute was used now. (See HELMETS). Other plate defenses are the laminated shoulder-pieces (epaulières); brassarts for the upper arm and coudières protecting the bend of the arm. Vambraces of cylindrical form protect from forearm to wrist, which latter is covered by the gauntlet cuff. Steel cuissarts, laminated skirts, surrounded the thighs. Plate genouillières guard the knees, first in a single plate, then reinforced above and below by steel lames. Grevières of steel surround shins and calves. Small pieces of mail termed goussets or gussets were at the back of the joints of the knee, shoulder, elbow and ankle. An elaborately ornamented hip-belt of large proportions, to which was attached the sword scabbard, was a characteristic of this period. The shield is rarely shown in contemporary illustrations. The great heaume (see HELMETS) was used for tilting and the bascinet for warfare.

Surcoatless Period (1410–30).—In this period arrives the full panoply of plate free from textile; even the camail disappeared. It was replaced by a plate gorget upon which the bascinet rested. The breastplate is now worn outside and is «globose» and has a back-plate (*dossiere*). Overlapping steel lames were attached below the breastplate and were termed *taces.* The hip-belt was worn around these. The shoulders had laminated epaulières as before but pallettes of different forms were attached to them. Brassarts, protecting the arms, were of riveted lames, but front and back plates were still in use. Coudières have often fan-shaped («shells») outer plates at the elbow joints. Vambraces remain unchanged. Gauntlets have larger cuffs. (See GAUNTLETS). Also the cuissarts, genouillières, grevières and solleres stay mostly as before. The sword at right and dagger at left hip remain. Shields are small and of various shapes. (See SHIELDS). The salade headpiece (see HELMETS) starts in use in this period.

Tabard Period (1430–1500).— These were years of war and armor improved in defensive power. The pieces became not only more completely protective but the metal was better tempered till offensive arms, even guns, found trouble in penetrating it. It was a period of evolving frequent changes; the tabard alone was constant, whence the use of the term for the time. The tabard was a sleeved surcoat usually decorated with the wearer's armorial bearings. Till 1450 the bascinet continued in a very short time to give place to the armet. The body was protected with the «globose» breastplate till about 1450 when it was reinforced with the «demi-placcate» (or *pansière*), a plate rising from the waist and curving upward to a point in the centre of the chest. Armhole gussets were now rigid or turned back. Backplates (*dossières*) about 1450 were formed of several pieces. Epaulières and brassarts for the right arm were laminated for rapid sword action after shivering the lance. The bridle (left) arm wore extra thick plates and reinforcements of many kinds. About 1430 the «pauldron» (shoulder piece) was introduced into England becoming larger and larger from a developed palette till it enclosed the entire shoulder and then grew up along the neck, evolving (latter part 15th century) the «passe-garde,» «garde-col» or «pike guard,» to protect the neck. The coudières by the middle of the century (as the shield had been discarded) became immense and uncouth. About this time appeared the «garde-de-bras» to protect the inside bend of the arm. The taces of this period decreased in number, exposing part of the thigh; the «tuilles» were now strapped below the taces to protect the front of the thigh, and they grew both longer and wider. Leg defenses remained as before till about 1440, when the genouillières became pointed below instead of being cut off square, and laminations appeared in the lower part and reinforcing plates to protect the thigh are added above. Pointed sollerets remained in use till about 1490, when «sabbatons» with square toes displaced them entirely. Tilting armor was composed of a harness built so heavy the knight could not mount his horse without assistance, but this was not used in warfare. The heaume had projections from the neck over the chest which allowed screwing it to the breastplate. Garde-de-bras, coudière and brassart were in use. An *épaule de mouton* (shoulder of mutton shape) is often a reinforcement piece for the right elbow. By the second half of the 15th century armor began to attain a form of great beauty, the style called «Gothic» being considered the most perfect in graceful outline. In this period fluted decoration is usual on fine harness. Both salade and armet-à-rondelle belong to this period.

Transition Period (1500–25).— The closed helmet (*armet*) came into more general use and a skirt of chain-mail (a characteristic of this period) was worn. The gorget was made up of laminated plates and extended over the chest and down the back. The «standard» or collar of mail came into vogue end of the period. The breastplate was «globose,» usually with taces of one or more lames. Pauldrons were reduced, less angular and composed of overlapping steel lames, a pike guard (*passe-garde*) was usually on top. Brassards, vambraces, coudières and gauntlets were of laminated steel; the coudières were reduced in size. Cuissarts, genouillières and grevières were composed of plate. Taces and tuilles are super-imposed on the mail-skirt. In general the characteristic changes of this period are reduced dimensions of some former parts, rounding of points and angles.

Maximilian Armor (1525–1600).—So termed from the name of the emperor (1459–1519), also has been termed «late Gothic.» The surface is adorned with close, narrow flutings (after that day's fashion in dress) or channelings. The vogue began to fall off after 1540. It is more solid and less flexible than the former style. Breastplates are shorter and rounded out more. The left pauldron is usually larger than the right. Sollerets are of the square «bear paw» or «cow mouth» toe. The burgonet, morion, armet and cabasset (see HELMETS) were worn in this period. Maximilian armor consists largely of decorative pageant pieces; it is a period of decadence. Breastplates with «tapul,» sloping forward to a median line, and the «peasecod» (bulging in an outward taper till nearer the bottom when it recedes sharply to the waist line) belong to this period. A frequent characteristic is the «rope» pattern on the edges of pieces. Some of the harness suits have a flaring, fluted skirt (*tonnelet*). Noted German armorers of the period were Kolman and Lorenz Helmschmidt, Mattheus Frauenpreis, Conrad Seusenhofer, Valentine Siebenburger, the Treyt family, etc. Tilting pieces were «Grande garde» for the left shoulder and side; «volante piece» to protect neck and face up to the eyes; «manteau d'armes,» left side protecting plate; «polder mitten» or «épaule-de-mouton» (literally *leg-of-mutton,* its shape), attached to vambrace to protect inside the elbow; «garde-bras» fastened to the coudière to protect the left arm. The shields were «rondaches» (see SHIELDS) highly decorated. The decoration of this parade armor consisted of beautiful hammered (*repoussé*) work, gold or silver inlay, damascening, etc.

Half Armor Period (from 1600).— The defensive quality of armor had passed in the former period; this period shows no full panoply but just a few uncouth «boiler-plate» pieces used as some protection against pistol shots, etc. The «three-quarter» suit contained, however, much of the cap-à-pied set except leg-armor (jambarts and sabbatons). Gradually armor parts were being discarded, some officers using only a cuirass over a «buff» (leather) coat; this, in Charles I's reign, was so common for entire regiments as to cause them to be termed «cuirassiers.» Dragoons wore a buff coat and metal burgonet. Lance regiments wore close helmet, gorget, breast and back plates, pauldrons, vambraces, tassets, garde-de-rein and gauntlets. Arquebusiers wore triple-barred helmets, cuirasses with garde-de-rein, pauldrons, vambraces. Pikemen wore morion-form of helmet, back and breastplates reaching to the waist, and tassets attached. In the Cromwellian period we get the «pikeman's pot» with cheek guards added. Musketeers wore morions till 1725, then felt hats with feathers. The 17th century armor pieces were thick, or heavy, enough to withstand pistol shots at short range and the bullet test mark appears on each piece. Great collections of armor are exceedingly few; the most representative in Europe are in Paris, Turin, Madrid, Vienna, Nuremberg, and in England those of the Tower of London, Windsor Castle, etc. America, in her New York Metropolitan Museum of Art, since the acquisition of the great Riggs collection, possesses as fine an assemblage of arms and armor as any in the world.

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Clement W. Coumbe.

PLATE GLASS. See Glass, Varieties of.

PLATE GLASS INSURANCE. After the repeal of the tax on glass windows in England in 1845 the glass industry took a great upward start, and in 1852 the Plate Glass Insurance Company was founded in London. The business spread rapidly; branches were established in New York and Australia, and the General Indemnity Insurance Company of London (1853) included a «Plate Glass» branch in its operations. Another company started a «Household Glass Department,» which insured mirrors, glass panels, chandeliers and windows, but not skylights. From these beginnings has grown an almost world-wide branch of financial activity in which the actuarial calculations of risk have reduced nearly to an exact science. The liabilities can be fixed to a degree of exactitude that does not obtain in any other form of indemnity. Losses are adjusted by replacing the damaged property by paying an indemnity to the assured equal in amount to what it would have cost the company to repair the damage. A specific premium is attached to every size of glass manufactured, and where these have been cut to smaller odd dimensions, the nearest even dimension is fixed as the basis of the premium charged. An elaborate system has been devised respecting the location of the windows, thickness of glass, depth of sash, etc., by which premiums chargeable can easily be arrived at. According to the ‘Cyclopedia of Insurance in the United States’ (1918), the 35 American and British companies handling this form of insurance transacted business to the amount of $5,903,528 in 1917, while net losses paid amounted to $2,890,851. Consult Sterling, N. D., ‘Plate Glass Insurance’ in ‘The Business of Insurance’ (Vol. II, New York 1912); ‘The Insurance Cyclopædia’ (Vol. V, pp. 415–422, London 1878); Winslow, E. H., ‘Some Facts about Plate Glass Insurance’ (*American Exchange and Review*, Baltimore, June 1911).

PLATE-MARKS. See Hall-marks.

PLATE AND PLATED WARE. The terms gold plate and silver plate are properly applied to articles or utensils of approximately solid metal, for use in the household or in religious ceremonials or purely for decorative purposes, as a prize cup. Articles of this character have from the remotest times and among all civilized nations been highly prized, and from their durability, intrinsic value and the beautiful forms into which they are often wrought have been esteemed the most precious heirlooms, and been held among the choicest family treasures through successive generations. The richest treasures of the temple of Solomon were of gold and silver plate, and such constituted the untold wealth taken by the Spanish conquerors of Peru from the ancient Incas. Though modern art has scarcely carried the manufacture of plate to higher perfection than that attained by skilful workmen of past centuries, it has succeeded in producing substitutes for it in what is called plated manufacture equally useful and almost as beautiful as the genuine plate, at prices that place within reach of those of moderate means what constitutes the luxuries of the rich. In the United States the industry of making silverware was begun by John Dixwell, Andrew Tyler and Edward Winslow of New England, and later Paul Revere, George Ridcout and Richard Van Dyke made silverware in New York before the Revolution. Later Rogers of Connecticut was a prominent manufacturer. He developed electroplating methods, and also achieved an enviable reputation for using the amount of silver that he guaranteed to put on. Thus the name of Rogers became a hall-mark of quality, and in the course of time there were four concerns making Rogers plated ware. Meriden, Conn., and Providence, R. I., are centres of the plating industry. See Electro-metallurgy.

PLATEAU, plā-tō, **Joseph Antoine Ferdinand,** Belgian physicist: b. Brussels, 14 Oct. 1801; d. Ghent, 15 Sept. 1883. In 1835 he became professor of experimental physics and astronomy in the University of Ghent, in which capacity he continued to serve until 1871. He became noted for his extensive researches in optics and molecular forces, his experiments being all the more wonderful from the fact that they were mostly done after he had become totally blind, the result of previous labors in the field of subjective vision. He was helped in these experiments by his son and son-in-law, who acted as his visuals. His chief work, and wherein his experiments and researches are described, was 'Statique expérimentale et théorique des liquides soumis aux seules Forces Moléculaires' (1873). Beside a short but comprehensive article on 'Persistence of Vision' (1876), he also published a bibliography of works relating to optics.

PLATEAU. See Plains; Table-land.

PLATEN-HALLERMÜND, plä'tĕn häl'lĕr-münt, **August,** Count von, German dramatist and poet, distinguished for his opposition to German Romanticism: b. Ausbach, Bavaria, 24 Oct. 1796; d. Syracuse, Sicily, 5 Dec. 1835. He received his education in the military academy at Munich; became a lieutenant in the Bavarian army and served throughout the campaign against France in 1815; subsequently obtained a furlough and took up the study of philology at Würzburg for two years and from 1819–25 at Erlangen. About this time he was awarded a stipend by the king of Bavaria which enabled him to satisfy his desire to study Oriental languages and literature by extensive travel. As regards Platen's writings much has been said both in praise and criticism; although in later years he became bitterly opposed to and often satirized Romanticism. Nevertheless his earlier works show to a great extent the effects of Romantic influence, and it is mostly for this contradiction that he is criticized. His first works, published in 1821, were poems written in the Persian form of the «gazel» under the title 'Ghaselen.' These poems were closely followed by 'Neue Ghaselen' (1824); 'Der gläserne Pantoffel' (1824), a poem which more than the others shows the Romantic influence; 'Sonnette aus Venedig,' or 'Sonnets from Venice' (1825), as beautiful a collection of sonnets as may be found in the German language; 'Der Schatz des Rhampsint' (1824); 'Die verhängnissvolle Gable,' 'The Fatal Fork' (1826), a satirical comedy attacking the «fate tragedy»; 'Der Romantische Œdipus' (1829), directed against Romanticism; an historic drama, 'Die Liga von Cambrai' (1833); and the legendary epic, 'Die Abbassiden' (1835). An edition of his collected works was published in two volumes (Stuttgart 1876). See Sonnets from Venice.

PLATFORM, Political. See Conventions, Political; Elections: Primary, Direct.

PLATING. See Electroplating; Plate and Plated Ware.

PLATINIRIDIUM, a native alloy of plattinum and iridium in varying proportions. It is found in small grains and crystals associated with native platinum.

PLATINUM. The first published notice of platinum is contained in the 'Relación historica del viage á la América Meridional,' issued in Madrid in 1748, wherein Don Antonio de Ulloa, one of the members of a French expedition for the measurement of an arc of the meridian, records his observation of the metal about 1735, in the district of Chocó, in what is now the Republic of Colombia. Here it bore the name «platina del Pinto» as it had been discovered in washings on the Rio Pinto; the name «platina» properly signifies «little silver.» In 1741 Dr. William Brownrigg received in London some specimens of the ore, sent to him from Jamaica by his relative, Charles Wood, who in turn had received them from the South American port of Cartagena, but had not been able to learn their exact origin. Wood stated that the Spaniards must have learned the art of fusing it, as they had already made numerous ornamental objects of it, such as sword-hilts, buckles, snuff-boxes, etc. Hence it appears evident that they must have discovered the metal many years before the date when it was first seen by Ulloa. The earliest scientific determination of platinum was made almost contemporaneously by Dr. Brownrigg, whose results were communicated to the Royal Society through Sir William Watson in 1751, and by the Swedish chemist Theophilus Scheffer, who laid his results in the same year before the Academy of Sciences in Stockholm. The latter received his specimens from Madrid, through a friend named Rodenskiæld. After pronouncing it to be «a perfect metal, as stable as gold or silver,» Scheffer proceeds to declare that «its nature most closely approaches that of gold,» from which it differed, however, by its tenacity, color, hardness and the degree of heat necessary for its fusion. The name «white gold» was chosen as a designation for platinum in the earliest known volume treating exclusively of it, published in Paris in 1758, and believed to have been written by Jean Morin, at one time professor of chemistry in a college at Chartres, France.* This little work gives French translations of all the scant platinum literature extant at that time. The use of platinum in the making of gold counterfeits is alluded to in the 'Encyclopédie' of Diderot and d'Alembert, published in 1774, wherein it is stated that some Hollanders on the South American coast had been deceived by having spurious gold ingots largely composed of platinum passed off on them. For this they took summary vengeance, as on their next voyage to the coast they seized the offending Spaniards and strung them up to the yard-arms of the Dutch ships. At about the same period, or not long after, a number of Spanish doubloons of platinum, with a thin plating of gold, were struck and successfully passed for a time. As platinum was then many times less valuable than gold such counterfeits realized a handsome profit for their dishonest fabricators, but to-day one of these counterfeit doubloons, the gold value of which if genuine would be about $8, would be intrinsically worth as much as $40. In the early part of the last century a number of similar counterfeits of United States $10 and $20 gold coins were made; several of which found their way to the Philadelphia Mint. Later still, however, from 1828 to 1845, a bona-fide platinum coinage was struck in Russia in denominations of 1, 3, 6 and 12 rubles; the coins contained some 2 per cent of iridium. The coinage value of the platinum was reckoned at about $7.15 a troy ounce, but at the present price a three-ruble piece instead of being worth $2.32 would bring nearly $35 of our money. Of these Russian coins 1,392,012 pieces were struck, having an aggregate weight of 473,907 troy ounces, or 14,738 kilos, and worth at the present price of the metal (1919) nearly $50,000,000.

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* L'Or blanc où le huitième métal (Paris 1758).

The honor of making the first platinum mass in Europe has been accorded to the French chemist Chabaneau, who accomplished the task in 1783 in Madrid, whither he had been called by Charles III to fill a special chair of mineralogy, physics and chemistry. This ingot weighed about 23 kilograms (some 740 ounces troy). At about this time Chabaneau made what is asserted to have been the first platinum article manufactured in Spain, a chalice which was bestowed by Charles III upon Pope Pius VI (1775–1800). The dedicatory inscription records that the chalice was made from "The first fruits of platinum rendered ductile by A. Fr.co Chavaneau." Almost contemporaneously the French chemist Achard worked the metal by alloying it with arsenic and then expelling the arsenic by heat. The method of making a compact metal out of platinum sponge by means of compression is said to have originated in 1800 with the Englishman, Thomas Cocke, although the credit has often been given to Wollaston. The modern method, by fusion before the oxyhydrogen flame, is credited to Dr. Hare of Philadelphia, who in 1837 produced in this way a homogeneous mass of platinum weighing 28 ounces (870 grams). The method was perfected by the French chemists Debray and Deville, and in the London Exhibition of 1862 the great English firm of platinum refiners, Johnson and Matthey, showed an ingot weighing 200 troy pounds, or nearly 75 kilograms. A platiniridium ingot made in Paris in 1874, in the course of the experiments to obtain proper material for the international metric standards, weighed 525 pounds. The ingot from which the standards were eventually cut was made by Johnson and Matthey. Platinum was found in the gold mines of Dakovlov, in the Urals, Russia, in 1819, in the sands of Neviansk, Bilimbayensk, in 1822, and in the Kurshinsk factories in 1824. In 1825 the rich deposits of the Nizhni-Tagilsk district were discovered. The largest platinum nugget met with in Russia came from this region; it weighed 23½ funts, or 9,628.88 grams (25 pounds, 9.45 ounces troy). Colombia, the first region where platinum was ever discovered and used, continues to furnish a notable quantity, the greatest of any land excepting Russia, though its production falls normally very far short of that of the latter land, which before the Great War supplied from 90 to 95 per cent of the entire production. The largest nugget found in Colombia weighed 800 grams; next to this comes one weighing 635 grams and containing 80 per cent of pure platinum.

Platinum is one of the most ductile of all known metals. It is so ductile that it can be drawn to the finest possible wire, then covered with a very thick coating of silver in wire form, then drawn again to infinitesimal fineness, the silver dissolved off, and this interior again coated with silver. So that one ounce of platinum wire could be made to stretch as great a distance as from New York to New Orleans, or from Buenos Aires across the Andes to the Pacific Ocean.

Although 99 per cent of the world's production of platinum comes from Russia and Colombia, small deposits of it have been found in many different parts of the earth. In the United States it occurs in Oregon, California, Wyoming, Washington, Nevada, Idaho, Arizona, New Mexico, Utah and Colorado, and it has occasionally been met with in other States, a fine nugget containing 38.1 grams, or almost one and one-quarter ounces troy, having been found about 1880 in glacial drift near Plattsburg, N. Y. It has also been mined in Ontario, Canada, as well as in British Columbia, and it is reported as occurring in Alaska. In Mexico and Honduras it has also been encountered. In South America, besides the important Colombian deposits, platinum occurs in Brazil, and a little has been reported from Ecuador and French Guiana, and from San Domingo. Borneo, Burma, Assam and Ava have also furnished small quantities, and a trifle has been discovered in the Bengal Presidency and in Mysore, India. In Europe it occurs in Norway, in Finnish Lapland, in Westphalia and in the Harz Mountains, Germany, as well as in Transylvania, and a trifle has been found in County Wicklow, Ireland. Quite recently there have been discovered very promising deposits, covering a wide area, in the Ronda Mountains, province of Malaga, Spain. On the African continent platinum has been met with in Algeria, in the Kongo Free State and in Cape Colony, as well as in Griqualand. Finally, notable deposits occur in Queensland and in New South Wales, Australia, and some has been found in New Zealand and in Tasmania as well. The chief sources of platinum are alluvial deposits, wherein it usually occurs either in rounded grains, or in scales which have been worn down by the attrition of the river gravel: occasionally, however, nuggets of quite considerable size are found. It is very commonly associated with gold, and usually with one or more of the different platinum metals, iridium, palladium, ruthenium, rhodium and osmium or the alloy iridosmium. It is opaque, with a metallic lustre; the color and streak are light steel-gray, shading into silver-white. There is no recognizable cleavage; the fracture is hackly. The hardness is fully four, and the specific gravity of native, unrefined platinum ranges from 14 to 19, this wide variation being due to the percentage of iron, or of palladium, ruthenium or rhodium that may be present; the specific gravity of refined platinum is 21.48–21.50. The atomic weight is 195.21 (O = 16). The coefficient of refraction was determined by Kundt to be 1.76 for red, 1.64 for white and 1.44 for blue, and Donde found, in reflected light, 2.06 for Na, 2.16 for red. The specific heat is 0.032 + and the coefficient of linear expansion about 0.0000049. Platinum is usually unaltered before the blowpipe, but it is readily fusible in the oxyhydrogen flame and in the electric arc, the melting point being about 1779° Centigrade, making it, after palladium, the most easily fusible of the platinum metals. It is not attacked by either boracic or phosphoric acid, nor by oxygen even when it is at a red heat, and but very slightly by pure hydrochloric acid, nitric acid or sulphuric acid. It dissolves soon, however, if treated with the mixture of nitric and hydrochloric acid, known as «aqua regia,» into platinum chloride, although an admixture of iridium or even of rhodium renders it somewhat more resistant. It forms alloys with gold and a number of other metals, the resultant alloy being more fusible than pure platinum. On the other hand, it gains greatly in hardness when alloyed with iridium, the product, called platin-iridium, being applied to a number of uses where hardness is especially to be desired. Chlorine, bromine and iodine attack it, and a mixture of bromine and hydrochloric acid works as actively as a dissolvent as does aqua regia. At a high temperature platinum combines directly with sulphur, phosphorus and arsenic. Easily fusible alloys of it may be made with potassium and sodium. As there is little difference between the specific gravity of gold and platinum, the miners are not able to separate the metals by the simple method of washing in habitual use, and recourse is had to quicksilver, which by combining with the gold to the exclusion of the platinum renders it possible to extract the latter. The method of refining platinum used in the United States assay office in New York is stated by the superintendent, Hon. Verne M. Bovie, to be the following: In the electrolytic process of refining gold, platinum remains in solution in the gold chloride electrolyte, from which it is precipitated by means of ammonium chloride. The precipitate is then well washed and reduced at a red heat to a metallic platinum sponge. This naturally contains impurities, and is, therefore, redissolved in aqua regia, and evaporated almost to dryness, so as to expel the nitric acid, sulphuric dioxide being then passed through it until all the gold is precipitated. Upon this it is oxidated to bring all the platinum into a platinic state and precipitated with pure ammonium chloride. The precipitate is now reduced in the usual way to metallic platinum sponge.

Chloroplatinic acid, H_2PtCl_6, is obtained by dissolving metallic platinum in aqua regia and then evaporating the solution. If this chloroplatinic acid is stood over caustic potash for a time and the residue is heated in chlorine gas to a temperature of about 350° Centigrade, the tetrachloride of platinum ($PtCl_4$) is formed, one of the most important salts derived from the metal. The addition of sodium or potassium to the tetrachloride gives, respectively, the chloroplatinate of sodium or of potassium. The salts of platinum are usefully applied as chemical reagents and in photography.

The finely divided form of platinum, known as «platinum black,» was discovered by Liebig. It possesses the striking property of absorbing and occluding oxygen in great quantity, taking up as much as 800 times its own bulk of the gas. This quality is also possessed to a marked but somewhat lesser degree by platinum sponge. Melted platinum, on cooling, emits the oxygen it has taken up with an intermittent crepitation. Ammonium platinum chloride, when heated to redness, becomes finely divided. A characteristic of the so-called «platinum-sponge,» which also absorbs and condenses gases, is that when brought into contact with hydrogen or coal gas, some of the occluded gas will be emitted as a flame. Many years ago Döbereiner utilized this property for a self-lighting lamp.

In the Bureau of Standards the purity of platinum ware is now tested by a simple thermoelectric method which leaves the object that has been tested absolutely unharmed. As the thermoelectric motive force of platinum against many of its alloys has been almost exactly determined, this is used as a test of purity. In testing a crucible, for example, two wires of pure platinum only 0.1 millimeter or 0.2 millimeter in diameter, are arc-soldered to the rim and are connected with an ordinary pyrometer-galvanometer or millivoltmeter. The junction-point of one of these wires with the crucible is heated by a small oxyhydrogen flame or other blast flame, while the corresponding junction-point of the other wire is kept cool by an air blast. An interposed sheet of asbestos prevents radiated heat passing from the heated to the cool part of the crucible; the temperatures are measured by a platinum thermocouple. The significance of the result is shown by reference to a chart giving the isothermal curves for the iridium or rhodium content of platinum.

While during the Great War the use of platinum for catalyzing processes in the production of concentrated sulphuric acid for the manufacture of explosives, for dehydrating nitric acid and for aeroplane and other war machinery, has been made especially prominent, the wide employment of it in electric appliances of various kinds is of at least equal importance. Large amounts of it have been used for dental work, because of its durability and its resistance to the action of acids. The latter reason has made it of the greatest possible value for various chemical vessels, such as crucibles, retorts, etc. Within the past 10 or 15 years it has been employed by manufacturing jewelers in many ways, for watch cases and for others of the smaller ornamental pieces, and for precious stone settings, more especially for diamond settings. Because of the imperative demand for platinum in the great war industries, the War Industries Board decreed that after 1 Oct. 1918 the use of this metal in the manufacture of new stocks of jewelry or for other non-essential purposes should be prohibited. The same law applied to iridium, palladium, osmium, ruthenium, rhodium and compounds thereof. It was said that the government had a sufficient supply on hand after commandeering the stock of unmanufactured metal, and the prohibition, therefore, did not extend to platinum jewelry already made up, which could be sold as heretofore, that is, by manufacturers or dealers licensed by the War Industries Board. The decree was the result of a special emergency act to effect government control over platinum, iridium and palladium, passed by Congress 6 Oct. 1917 and amended 1 July 1918. The situation at that time, after a careful survey, was recognized as serious. Platinum in the United States sold in 1890 at $16 per troy ounce and is selling now at $105 per troy ounce, five times the cost of gold. This situation arose directly from the embargoes of 1915 put upon the exportation from the countries at war, England, France, Germany and Russia, and from the practical cessation of the Russian supply, followed by increased demands after our entry into the war. Prior to the war Russia had furnished 95 per cent of the world's entire stock. All this has induced an active search for substitutes which might prove more or less satisfactory, and alloys of gold and palladium, or of gold and osmium, or gold and nickel, have been used with fairly good results in many cases. The shortage has also stimulated the search for platinum, not only in the metallic deposits of various parts of the United States, but throughout the entire world, and several new, minor sources have come to light. It is possible that a change in metallurgical methods may furnish a quantity of platinum and palladium from certain Canadian sources that is not now recovered, and that United States and Colombian resources may be developed to a greater extent. Of the 5,000,000 or more ounces of platinum already in existence, it has been estimated very conservatively that catalyzing processes have claimed 500,000 ounces, dental uses 1,000,000, chemical apparatus 1,000,000 ounces, electrical devices 500,000 ounces and jewelry 500,000. These estimates are probably set rather too low in view of the fact that the total production of the metal has certainly been as much as 5,000,000 ounces; indeed some authorities have placed the total Russian production alone as high as 7,000,000 ounces. Of course, this was crude platinum and would furnish only about 5,800,000 ounces of the refined metal. In the period from 1900 to 1917 the imports of unmanufactured platinum, and of bars and ingots, into the United States, have had a total weight of 52,767.2 kilos, or 1,696,711 troy ounces and a total value of $48,981,879. To this must be added imports of crucibles, retorts, etc., worth $2,302,236, giving a total value of platinum in all forms of $51,284,115. Of course, a good proportion of the import was crude platinum.

For the fiscal year ending 30 June 1918, the imports of unmanufactured platinum, and of bars and ingots, weighed 1,613.1 kilos, or 51,862 troy ounces, and were worth $4,572,614; the retorts, vases, etc., were valued at but $2,547, giving a total of $4,575,161 for all platinum imports to the United States. Of this Colombia contributed $2,241,744 (27,030 troy ounces), just about half the total value and a little more than half the weight. A single, special shipment of 21,000 ounces from Russia, acquired for $2,000,000, accounted for most of the remainder.

The value of platinum, as measured by that of gold, has varied enormously in the course of years. About 1788 Colombian platinum was bought by the Spanish Royal Mint at a price equalling some 14 cents an ounce troy. At the time the Russian platinum coins were struck (from 1828 to 1845) the metal was reckoned to be worth but $7.15 an ounce troy. Fifty or 60 years later the price had increased greatly, rising from about $20 an ounce in 1906, to $45–$46 in 1911–13. With the advent of the great war, the interruption of Russian production and the increased demand for special uses caused the price to mount rapidly to $105 and even higher. When, in 1918, the United States government assumed control of the platinum market, it established the price of $105 per ounce for pure platinum.

The five allied platinum metals of the platinum group, making six in all, palladium, osmium, iridium, ruthenium and rhodium, as well as the combination osmiridium (iridosmine), each have their special characteristics and usefulness.

Palladium was found in 1803 by Wollaston as a constituent of crude platinum from Chocó, Colombia. Its name was suggested by the then recently sighted planetoid Pallas, discovered by the German astronomer Olbers in 1802. The melting point of palladium is between 1,360° and 1,380° C. and its hardness is from four to five; the specific gravity is 11.4. It is more easily fusible than platinum, indeed, it has the lowest melting point of any of the platinum metals. It has been much used for alloys in astronomical instruments and also in dentistry. In clock-making it has found employment for springs and movements. In 1919 it sold for $135 the ounce, troy.

Osmium is one of the heaviest of these metals, its specific gravity ranging from 21.3 to 22.48. It was discovered in 1804 by Smithson Tennant in the residuum of South American crude platinum, after it had been treated with aqua regia. The name (from Greek *osme*, "smell") was bestowed because of the peculiar odor emitted by its volatile oxide.

Iridium was discovered by Tennant in 1804 and in the same way as osmium. Its hardness is between six and seven, that of platinum being only about four, and its specific gravity of from 22.6 to 22.8 makes it the heaviest of the platinum group. Its melting point is about 2,200° C. The name (from Iris) was chosen because of the variegated hues of its oxide.

The combination of osmium and iridium, to which the name osmiridium or iridosmine has been given, was first observed by Wollaston in 1805. Some mineralogists have used the designations iridosmine and osmiridium as signifying a lighter-hued and a darker-hued form of the alloy, respectively.

Rhodium, discovered in 1804 by Wollaston, occurs in some platinum ores. The color is a grayish-white. Its fusion point is as high as 1,940° C. While very hard, the specific gravity is low, not exceeding 12.1. Rhodium has been less used than any other of the platinum metals.

Still another metallic element found in association with platinum bears the name ruthenium. It is obtainable from the residuum resulting from the separation of osmium from osmiridium. The specific gravity is only 12.26. Ruthenium is practically unattackable by acids. It was discovered by Claus in 1845. The designation, derived from Ruthenia, an ancient name of Russia, had been applied in 1826 by Osann to one of three new metals he claimed to have found associated with platinum, another of which, his pluran, was probably the true ruthenium; his ruthenium and «polin» were subsequently shown by Claus to be errors.*

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George F. Kunz.

PLATNER, Samuel Ball, American Latinist: b. Unionville, Conn., 4 Dec. 1863. In 1883 he was graduated at Yale University, where he received the degree of D.Ph. in 1885. In 1885–90 he was instructor in Latin and French; in 1890–92 assistant professor of Latin, and after 1892 professor at Western Reserve University. In 1897–1911 Dr. Platner was secretary to the managing committee and in 1899–1900 professor in the American School of Classical Studies in Rome. In 1900–01 he was president of the American Philological Association. He edited Müller's 'Greek and Roman Versification' (1892); 'Selected Letters of the Younger Pliny' (1894) and wrote 'Topography and Monuments of Ancient Rome' (1904; 2d ed., 1911).

PLATO (Gr. *πλάπων*, «broad,» a sobriquet given by Ariston, a teacher in athletics, and referring probably to Plato's broad shoulders), was born in Athens in the deme of Collytus, in 427 B.C., of aristocratic parentage, and died there in 347. According to an ancient tradition he was born on the 7th of Thargelion, Apollo's Day, which, in Olympiad 88.1 (accepting the Metonian canon), fell on 29 May, Julian calendar. His original name was Aristocles, the name of his grandfather. His father's name was Ariston, of the line of Codrus, last of the kings of Athens, and his mother was Perictione, of the line of Solon, greatest of the Athenian archons. In many respects Solon was Plato's political exemplar, for Solon was at once philosopher and statesman. Plato distinguished himself in his early youth as an athlete, having wrestled in the Isthmian games at Corinth, and there is a doubtful tradition that he was once victor at Olympia. Before he was 20 he had written dramatic and lyric verse assiduously and with success. The most important event in his earlier life was his meeting with Socrates in 407. This event was decisive for his later career. He had already studied philosophy under the Heraclitean Cratylus, but from 407 to the death of Socrates in 399 he was entirely absorbed in the dialectic of his new master, whose chief disciple and most complete interpreter he became. Immediately after the death of Socrates in prison (Plato, owing to illness, was not present), the disciple went to Megara, where, with his friend Euclid, he studied the Eleatic philosophy. After a brief residence in Megara, it is probable that he returned to Athens, and thereafter made extensive journeys to Egypt, Cyrene in Africa, Italy and Sicily. In Cyrene he visited the mathematician Theodorus. In Italy he was befriended by the famous ruler, Pythagorean philosopher and military leader, Archytas of Tarentum. In Sicily he formed an intimate friendship with Dion, brother-in-law of the elder Dionysius. Dionysius, then ruler of Syracuse, was offended by Plato's free criticism of the government, and turned him over to the Lacedæmonian Ambassador, Pollio, to be sold as a slave. He was brought to Ægina, where Anniceris (of the Cyrenaic school) ransomed him. After his release a plot of ground hard by the academy was bought for the use of Plato's school, which then took the name of the adjoining gymnasium (academy). Plato established his academy in 387 and presided over it until his death in 347. The foundation of the academy thus dates from the exact middle of his life. Two later journeys were made to Sicily, one in 367, on the accession of Dionysius the Younger, and one in 361, both for purpose of political experiment, but without success. Indeed, on the last visit his life was put in jeopardy by the distrust of Dionysius. Thereafter he made no further attempts in practical statescraft, but carried forward continuously his scientific and literary work at the academy, where, in his early teaching, he employed a dialogic method (after the manner of his master, Socrates), and later the more dogmatic lecture. He died in 347 (according to tradition on his birthday, having thus completed exactly four score years), as Cicero says, *scribens,* «pen in hand» (*De Senectute,* v. 13). His tomb near the academy, in the Ceramicus, was still to be seen at the beginning of the Christian era.

Writings.— No work of Plato known to antiquity has been lost. On the contrary, the present *corpus* contains more than the genuine list of works. The traditional Platonic canon (that of Thrasyllus in nine tetralogies, accepted entire by Grote) contains 36 works (counting the letters as one), divided into 56 books. The works are written almost entirely (excepting the 'Apology') in dialogue, a form which grew out of the Socratic conversations, which these writings purport to reproduce. They are not systematic treatises, but rather essays, the earlier of which are more peirastic and the later more dogmatic (cf. Pater's 'Plato and Platonism,' pp. 157–159). Their chronology represents the gradual philosophical evolution of Plato's own mind, and not any preconceived pedagogical plan. Regarding the determination of the sequence or dates of the dialogues, no consensus of opinion among Platonic scholars has been reached. The most important dialogues are the ‘Symposium’ (on Love), the ‘Phædo’ (on the Immortality of the Soul), the ‘Republic’ (on the Ideal State), the ‘Theætetus’ (on the Nature of Knowledge), and the ‘Timæus’ (on the Nature of the Physical World). Three periods of composition may be differentiated, namely: (1) A Socratic or Ethical period, in which the anti-sophistic dialogues were written. This period may be regarded as extending from 398 to 387, that is, from the beginning of Plato's philosophical writing to the opening of the academy; (2) a Metaphysical and Constructive period, in which Plato builds the Socratic concept into its metaphysical form, develops the theory of ideas, invents his great myths, constructs the ideal state, and reaches the climax of his intellectual and literary genius — a period extending from 387 to 360; (3) a third period, marked by increasing mysticism and decreasing literary and philosophic power, a growing ascendency of Pythagoreanism and mathematical symbolism, a less daring civic ideal, a more dogmatic and less versatile manner of utterance and a greater emergence of religious interest — a period extending from the last Sicilian journey, or about 360, to his death in 347. See Plato's Republic; Symposium; Platonism.

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* Hintze, 'Handbuch der Mineralogie' (Leipzig 1904, p. 141); Consult G. Osann, 'Untersuchung der russischen Platina' (Ann. der Phys. Pogg. Vol. VIII, 1826, p. 505), and C. Claus, 'Untersuchung des Platinrückstandes, nebst vorläufiger Ankundigung eines neuen Metalles (Ruthenium)' (Bull. Acad. Sci. St. Petersburg, Vol. III, 1845, pp. 38, 311, 354).

I. *The Socratic and Anti-Sophistic Group,* 398–387: (1) ‘Apology’; (2) ‘Euthyphro’; (3) ‘‘Crito’; (4) ‘Lysis’; (5) ‘Charmides’; (6) ‘Hippias II’; (7) ‘Laches’; (8) ‘Protagoras’; (9) ‘Meno’; (10) ‘Euthydemus’; (11) ‘Gorgias’; (12) ‘Republic,’ Books I and II; or, in the pagination of Stephanus, from 327 to 368 A.

II. *The Metaphysical and Constructive Group,* 387–360: (13) ‘Cratylus; (14) ‘Symposium’; (15) ‘Phædo’; (16) ‘Republic,’ Book II, 368 A to Book V (inclusive), and Books VIII–X; (17) ‘Phædrus’; (18) ‘Theætetus’; (19) ‘Parmenides’; (20) ‘Republic,’ Books VI–VII, and reconstruction and unification of the entire work, Books I–X; (21) ‘Sophist’; (22) ‘Politicus’; (23) ‘Philebus.’

III. *The Physico-mathematical and Politico-religious* Group, 360–347: (24) ‘Timæus’; (25) ‘Critias’; (26) ‘Laws.’

The following are spurious: ‘Alcibiades I and II,’ ‘Hipparchus,’ ‘Clitophon,’ ‘Theages,’ ‘Minos,’ ‘Epinomis,’ ‘Axiochus.’ ‘Letters,’ ‘Hippias I,’ ‘Amatores,’ ‘Definitiones,’ ‘Ion,’ ‘Demodocus,’ ‘Eryxias,’ ‘De Justo,’ ‘De Virtute,’ ‘Timæus Locrus,’ ‘Menexenus.’

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Translations.— Schleiermacher (with introductions, 3d ed., Berlin 1855–62); Cousin (13 vols., Paris 1825–40, 2d ed., Vol. I, by Barthélemy, Saint-Hilaire, ib. 1892); Jowett (3rd ed., 5 vols., New York and London 1892); Fowler in ‘Loeb Classical Library’ (New York 1913 ff.).

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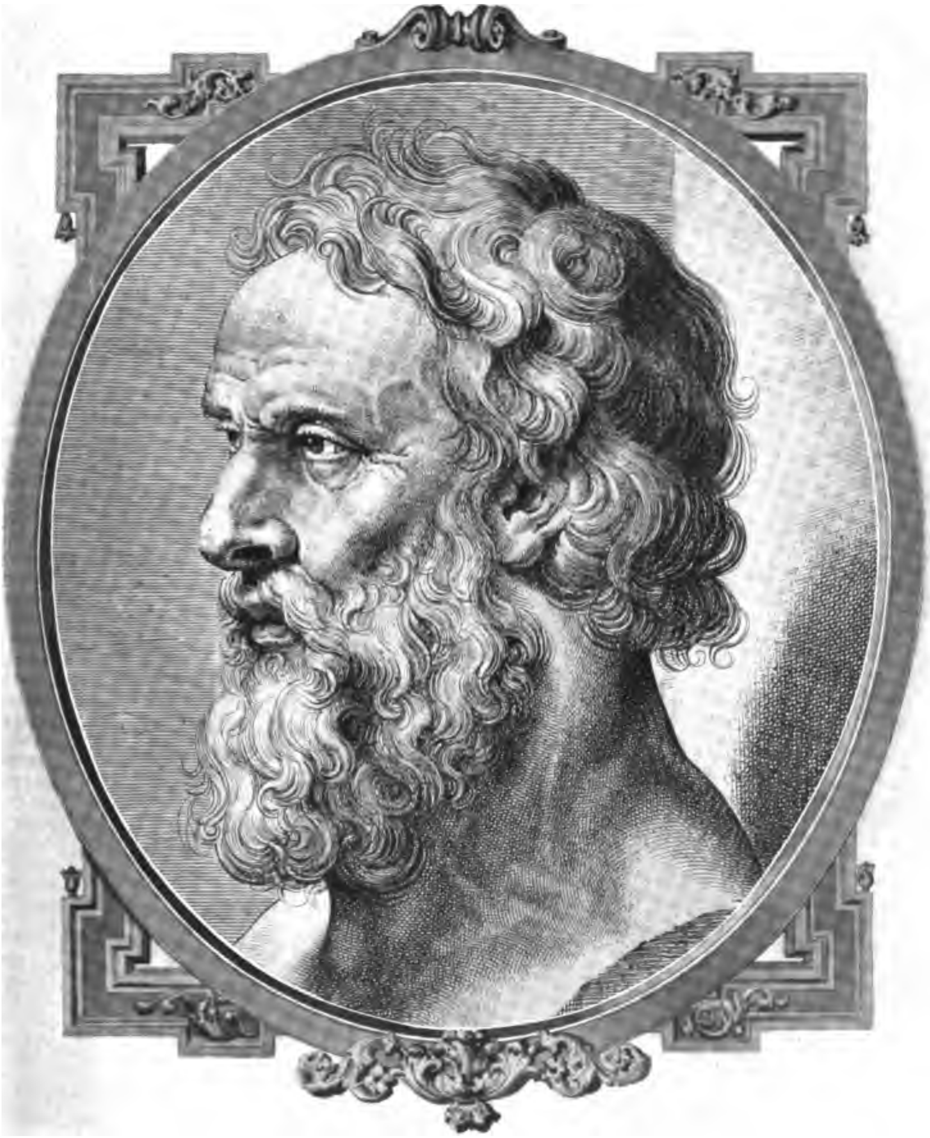
PLATOFF, plä'tōf, or **PLATOW, Matvei Ivanovitch,** Count, Russian general and hetman of the Cossacks: b. on banks of Don River, Russia, 17 Aug. 1751; d. Tcherkask, Russia, February 1818. He entered young into the military service, was employed against the Turks in Moldavia, and was made a general of cavalry. When the French invaded Russia in 1812 Platoff was again called into service, and though defeated at Grodno and obliged to retire into the interior, returned during the retreat of the enemy from Moscow, and with 20 regiments of Cossacks harassed them in their flight, and contributed greatly to the advantages gained over them. In 1813 he defeated Lefebvre at Altenburg, and after the defeat of the French at Leipzig entered France, and was at Paris with the Emperor Alexander, whom he accompanied to England. At London he was the object of popular admiration, and a magnificent sabre was presented to him. In 1815 he commanded the Cossacks destined for the second invasion of France, and again made his appearance at Paris. After the restoration of peace he retired to Tcherkask.

PLATONIC YEAR, the name given the period of time which the equinoxes take to finish their revolution, at the end of which the stars and constellations have the same place with regard to the equinoxes that they had at first. Tycho Brahe says this year or period requires 25,816 common years to complete it; Ricciolus computes it at 25,920; and Cassini at 24,800; at the end of which time some imagined that there would be a total and natural renovation of the whole creation.

PLATONISM, the system of philosophy taught by Plato. The tripartite division of philosophy into Dialectic (Metaphysics), Physics and Ethics is not explicitly made by Plato, although these several disciplines are discussed in the various dialogues and the classification is implicitly made.

Platonic Metaphysics.— The fundamental discipline in the Platonic philosophy is the Metaphysics, and the central doctrine in this discipline is the doctrine of ideas. The basic elements of the doctrine are derived from preceding philosophies, although they are here reconstructed with creative genius into a new system. The Platonic ontology is an attempt to mediate between the metaphysical antithesis of Heracliteanism (the philosophy of becoming or «flux,»



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geographical limits mentioned; the Bible was translated into Plattdeutsch before any version into High German was made; but Luther's Bible having been composed in High German and circulated as no book ever before — one bookseller in Wittenberg sold in 40 years 100,000 copies, and before 1559 it was reprinted in 38 editions — the High German dialect was recognized thenceforth as the superior literary medium. The Plattdeutsch accordingly went into decline, the issues from the press in that dialect growing gradually fewer till, in the end of the 17th century, its literary use had practically ceased. But in recent times there has been a revival of Plattdeutsch literature, and the several Low German dialects have received a good deal of attention from linguistic scholars. The oldest extant literary monument of the Low German language is the 'Hêliand' (healer or savior), a history of the life of Christ composed in alliterative verse; it was written about the year 830 by a Saxon cleric or monk.

PLATTE, plăt, a river which rises in the Rocky Mountains, formed by the junction of two streams called the North and South Forks of the Platte. The total drainage area is over 100,000 square miles. The North Platte is formed by the union of several streams in the North Park, Colorado, and the South Platte takes its rise in the South Park. They flow east and unite in Lincoln County, Neb., about 400 miles from their source, while the united stream, also flowing mostly east, crosses Nebraska and enters the Missouri on the border of Iowa, 15 miles below Omaha, after a course of about 1,600 miles. The principal affluents are the Elkhorn and the Loup Fork. The river is from one to three miles broad, but is so shallow that it is not navigable. The South Platte in its upper course is extensively used for irrigation and as a source of water power.

PLATTE COUNTRY, THE, in American history, a name applied prior to 1854, given to the territory stretching west from Missouri to the Rocky Mountains, and which now comprises the States of Kansas and Nebraska. A bill was introduced into Congress in 1854 by Douglas of Illinois for the organization of the territory, the slavery question to be determined by the inhabitants, in direct violation of the Missouri Compromise.

PLATTENSEE, plät'tĕn-zā. See BALATON.

PLATTER, plät'tėr, **Thomas**, Swiss scholar and humanist educator: b. Grenchen, near Visp, in 1499; d. Bâle, 1582. In his boyhood he was a goat-herder in the mountains, but later his mother sent him to the local priest for instruction. He soon outgrew the narrow limits of the education obtainable from this source and became a wandering scholar. In company with a cousin he wandered throughout Germany, leading the wretched life of bacchants, but this became distasteful and he separated from his companion and entered the school at Schlestadt under Jean Sapidus to study Latin. Some time later he went to Zürich to study under Myconius, and while there learned the trade of rope-making, which enabled him to continue his studies of Greek and Hebrew. In 1541 he became professor of Greek in the gymnasium at Bâle and continued in that capacity until 1578. Platter's most important work was his autobiography, written at the request of his son Felix (1536–1614). The document gives an interesting history of education in the 16th century and shows the life of the students and scholars of that time, besides telling of his own travels. It was published in the original in 1840 and later the biographies of the father and son were edited together by Heman (Gütersloh 1882).

PLATTEVILLE, plăt'vĭl, Wis., city in Grant County, on the Chicago and Northern and the Chicago, Milwaukee and Saint Paul railroads, near the southwest corner of the State and about 20 miles northeast of Dubuque, Iowa. It was settled in 1827. It is in a fertile agricultural region, and in the vicinity are lead and zinc mines. The chief manufacturing establishments are a brewery, creamery, wagon factory, cigar factory and machine shop. It is the seat of a State normal school. The city owns and operates the waterworks. Pop. 4,452.

PLATTNER, plät'nėr, **Karl Friedrich**, German chemist and metallurgist: b. Kleinwaltersdorf, near Freiberg, Saxony, 2 Jan. 1800; d. Freiberg, 22 Jan. 1858. Very little is known of his early life until 1842, when he became professor of metallurgy at Freiberg, a post he held there until 1857. During this time he experimented with marked success, but he became noted mostly through his application of the blow-pipe to the quantitative assay of metals. He published 'Probirkunst mit dem Löthrohr' (1835), etc.

PLATTSBURG, plăts'bėrg, N. Y., village, port of entry, county-seat of Clinton County, on Lake Champlain, at the mouth of the Saranac River and on the Delaware and Hudson and the Chateaugay railroads. It has steamer connection with Burlington, Vt., and all the lake ports. It is about 160 miles north of Albany. It was settled in 1784 by a colony from Long Island and Poughkeepsie in charge of Zephaniah Platt, in whose honor the place was named. It was incorporated as a town the next year. It was the scene or near the scene of some of the important engagements of the Revolutionary War and the War of 1812. The first naval battle between American and British forces took place 11 Oct. 1776, off Valcour Island, a short distance from Plattsburg. Benedict Arnold was in command of the American forces and Sir Guy Carleton of the British. This battle was won by the British. Plattsburg was headquarters for the American forces on the northeastern frontier in the War of 1812. On 11 Sept. 1814 another engagement took place on Cumberland Bay, an inlet of Lake Champlain (q.v.), while at the same time the British made a land attack. Commodore MacDonough (q.v.), commander of the American forces, won the naval victory and General Macomb was equally successful in defeating the British forces on land. The steady growth of the village was checked by fire on two occasions, in 1849 and 1867, when many of the business houses were destroyed.

Adjoining the village on the south is a United States military reservation of 679 acres. In 1838 a United States military post was established here, and barracks erected sufficient to accommodate a regiment of infantry. South of the «Plattsburg Barracks» and on Lake Champlain is Cliff Haven, the home of the Catholic Summer School of America (q.v.). Plattsburg and the region around are favorite summer resorts, and an important military training camp is located there. The lake on the east and the Adirondacks on the west furnish a variety of beautiful scenery and greatly modify the temperature during the summer months. It is the commercial and industrial centre for nearly all of Clinton County. The chief industries are lumber mills, sewing-machine works, typewriters, motors and automobiles, foundries, machine shops, flour mills, woolen goods factory and wood-pulp mills. It has the Vilas Home for Aged Women, a government building, courthouse, several fine church and school buildings. It is the seat of the Plattsburg State Normal and Training School and of D'Youville Academy. It was a high school, public elementary schools, a village public library and four other libraries. Pop. 10,134.

PLATTSBURG, Battle of. See CHAMPLAIN, LAKE, BATTLE OF, IN WAR OF 1812.

PLATTSBURG BARRACKS, a military post established by the United States in 1838 on the west shore of Lake Champlain just south of the city of Plattsburg, N. Y., on the Delaware and Hudson Railroad. It has the usual equipment of a military post, but the surrounding site has been frequently used as a practice camp, especially in 1916 during the «preparedness» agitation. Business men and college men were there trained to become officers under competent instructors furnished by the War Department.

PLATTSMOUTH, Neb., city, county-seat of Cass County, on the Missouri River, at the mouth of the Platte River and on the Chicago, Burlington and Quincy and the Missouri Pacific railroads, 21 miles south of Omaha. It is in a productive agricultural section and has considerable manufacturing interests. The chief industrial establishments are the Chicago, Burlington and Quincy Railroad shops, clay product works, cigar factories and machine shops. The export trade is chiefly in grain, vegetables and live-stock. The public school system is excellent, consisting of a high school which cost $25,000, supplemented by eight graded public schools; there are 11 church edifices; a courthouse erected at a cost of $80,000, and a large opera-house. There are three banks — one national and two State — with a combined capital of $150,000. The city is lighted by gas and electric light; has improved waterworks and a sewerage system. There is a daily and a semiweekly newspaper. The government is vested in a mayor, who holds office two years, and a council. Pop. 4,287.

PLATYHELMINTHES, a phylum of the Metazoa, commonly known as the flatworms, characterized by a bilaterally symmetrical body, somewhat flattened dorsoventrally and usually elongated. The primary body cavity is filled with parenchymatous tissue, giving characteristic firmness to the body. The alimentary system is sacculate and provided with but a single opening, and the excretory organs are of the simple protonephridial type. On the other hand the reproductive organs are unusually complex, and in all save a few species hermaphroditic. The phylum is well defined, containing three great classes, the Turbellaria or free-living flatworms, the Trematoda or flukes, and the Cestoda or tapeworms. Of the few aberrant or little known groups formerly associated with this phylum only the Nemertinea are still placed here; they are given independent rank, and usually treated as an appendix though often omitted entirely from the phylum. The body is covered in the Turbellaria by a simple ciliated epithelium, and in the Trematoda and Cestoda by a so-called cuticula which has not been clearly interpreted as yet since the epithelial cells are apparently wanting though glandular cells sunk deep in the parenchyma are often interpreted as epithelial in origin. Directly beneath the epithelium or the cuticula one finds a well developed dermo-muscular sac in which longitudinal and transverse layers are always seen and often a third layer made up of oblique bundles. Dorsoventral muscles extend through the parenchyma from surface to surface and special muscles are also found in connection with organs like the suckers, spines, etc. There is no skeleton and the only hard parts present are hooks and spines that develop on the surface of the body or of some invagination of the external layer.

Special circulatory and respiratory organs are entirely lacking, but the excretory system is well developed. It consists of so-called «flame cells», i.e., ciliated cells, that close the inner ends of minute tubules; these form a branching system that leads to one, two, or more external pores. Just within the pore one finds often a storage bladder formed by an expansion of the tubule. Asexual reproduction by division is common in the Turbellaria and metagenesis or alternation of generations occurs in Trematoda and some Cestoda. Although nearly all Platyhelminthes are hermaphroditic a single germ gland produces only one kind of sex cells and the complex reproductive system, which forms the conspicuous part of the body in the sexually mature individual, comprises a complete set of male and of female organs. Development is simple in the free living Turbellaria and often very greatly involved in the parasitic Trematoda and Cestoda where alternation of hosts is the rule and even three or four hosts participate in the life history of a given species. Many efforts have been made to trace relationship between the Platyhelminthes and the Cœlenterata on the one hand and the higher worms or simplest mollusks on the other. While one recognizes in general the intermediate character of the flatworms, it has not yet been feasible to trace more definite connections in either direction. The process of change within the phylum is distinctly traceable from the free living Turbellaria with ciliated epithelium and special sense organs that show adaption to independent existence through the ectoparasitic and endoparasitic Trematoda to the Cestoda. In the latter the consistent endoparasitic habit is correlated with entire disappearance of the alimentary canal as well as with the loss of ciliary locomotor apparatus and special sense organs. Consult Lankester, 'Zoology' (London 1901) and Her-twig-Kingsley, 'Manual of Zoology' (New York 1912).

PLATYPUS, a genus of monotremes, called *ornithoryncus*, peculiar to New Holland, seemingly a link between the aquatic bird and the mammalia. It is about 12 inches in length, covered with a thick, soft fur, dark brown above, and whitish beneath. The muzzle is elongated, enlarged, flattened; the teeth are situate in the back part of the mouth, two on each side; the feet are webbed, and the hind legs are armed with spurs which secrete a poisonous fluid; the tail is flat and obtuse; there is no external ear and the eyes are very small. The echidna or spinous ant-eater is a genus resembling the platypus, but not amphibious. See DUCKBILL.

PLAUEN, plou'ĕn, Saxony, town situated on the White Elster, 20 miles south by west of Zurickau. It contains an old castle, Rathaus, theatre, gymnasium, Realschule, teachers' training school, etc. It is one of the most important cotton-manufacturing centres of the country, turning out great quantities of cambric, lace, muslin, batiste, embroidered goods, etc. Other industries produce pianos, paper, safes, machinery, etc. Pop. 121,272.

PLAUTUS, the third of the Roman dramatists in chronological order and the first in literary and linguistic importance. His full name was Titus Maccius Plautus; it was formerly supposed to be M. Accius Plautus and is so given in editions before 1850. He was born in Sarsina, a small Umbrian town, about 254 B.C., probably of free parents, but in humble station. Of the events of his life only three are known definitely: the 'Stichus' was written by him for the plebian games in 200 B.C.; the 'Pseudolus' was given at the dedication of the temple of the Magna Mater in 191; he died in 184. There is a brief notice of his literary activity in Gellius, iii, 3, 14, in which it is stated that after coming to Rome he was engaged in some work connected with the stage, that he used the money thus earned in trading by sea and having lost it, he returned to Rome in such straits that he was obliged to support himself by grinding at a mill; that while so occupied he wrote three plays and began his career as a dramatist. This account is said to be taken from Varro, but it contains some evident inconsistencies, and it is not improbable that it is a grammarian's construction, based upon supposed personal references in the plays and put together after the analogy of the literary Lives written by Greek grammarians. The uncertainties which attend the attempt to reconstruct the earlier Roman history are especially great in matters of literary history, which were not of sufficient importance to be officially recorded.

Of the writings of Plautus, 20 plays have come down to us, with considerable fragments of a 21st. But it is probable that these constitute only a part of his work. During the century of dramatic activity in Rome (c. 250–150 B.C.), there was no established theatre in the city, nor were there frequent presentations of plays. The genuine plays of Platus became confused with others which passed under his name, so that later traditions varied, some assigning to him as many as 130 plays, others as few as 21. There was during his lifetime no reading public, but in the half-century after 150 the plays came into circulation for reading and efforts were made by critics to distinguish the genuine from the spurious. This culminated in the fixing by Varro of a canon of 21 plays which were regarded by all critics as Plautine, and which are beyond reasonable doubt the plays that we now possess. Of the 20, the best known are 'The Captivi,' 'Trinummus,' 'Menaechmi' and 'Aulularia,' partly because they are most suitable for class-room reading; the 'Bacchides,' 'Pseudolus,' 'Rudens' and 'Miles Gloriosus' are superior to them in style and humor. About half the plays are corrupt in text, or fragmentary or of inferior merit.

The comedies of Plautus are based upon Greek plays of the New Comedy (c. 321–250 B.C.), and in a few cases Greek poets — Menander, Philemon, Diphilus — are named. His plays therefore illustrate that fusion of Greek form with Roman spirit which is generally characteristic of Latin literature. The plots, with their fundamental element of trickery, are wholly Greek, as are the characters and situations, at least in outline, and the subject-matter of the plays is the social and family life of a Greek city. Plautus was himself a man of Italian temperament; he was able to make the Greek plots and characters the vehicle for the expression of a genuine and original humor, to fill in the Greek outlines with the rich Italian coloring. In some plays, for example, in the 'Captivi,' the fusion is not complete and a certain degree of incongruity may be detected; in others, as in the 'Bacchides,' the hearty and almost riotous humor blends the two elements into a harmonious whole. That he truly expressed the spirit of his race is evident from his popularity during his lifetime and from the long-continued presentation of his plays upon the Roman stage. His comedy has not been without influence also upon modern literature; Molière founded his 'L'Avare' upon the 'Aulularia,' and Shakespeare's 'Comedy of Errors' is an adaption of the 'Menaechmi.'

Bibliography.— The best complete edition is the Teubner text by Goetz and Schoell, a condensation of the great critical edition begun by Ritschel in 1848 and completed by his three pupils, Goetz, Schoell and Loewe, in 1894. There are good commentaries on single plays by Brix and Lorenz, and in English by Tyrell and Sonnenschein. In Sellar's 'Roman Poets of the Republic' may be found an excellent essay upon the literary qualities of Plautus. No complete English translation has appeared since Thornton's (2d ed., 5 vols., 1769).

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PLAY. Various phenomena connected with the play of man and of animals have recently attracted the attention of both biologists and psychologists. These two lines of inquiry may be summed up in the two questions: (1) What is the function of play in the life of the organism? and (2) what are the essential psychological characteristics of play as distinguished from those of ordinary mental life?

In answer to the first question three theories have been advanced each of which seems to contain an element of truth. (1) There is the "surplus-energy" theory of Spencer according to which play is the natural outlet of the surplus energy that has accumulated in a vigorous organism. (2) The «practice» theory worked out most fully by Groos according to which play has a positive function in the life of the animal as affording practice and preparation for the serious activities of life. (3) The «recuperative» theory that regards the play-activities as fulfilling their proper function in affording an opportunity for the rest or recuperation on the part of the other activities.

From the psychological side it has sometimes been held that «shamming» or semblance (often resulting in real self-illusion) is an essential of all play; but this mark does not seem to be present in all cases. The real differentia of play is perhaps found in the fact that the end of play is always the pleasure of the activity itself while work has always some end beyond the activity. Consult Spencer, ‹Principles of Psychology›; Groos, ‹The Play of Man,› and ‹The Play of Animals.›

PLAY CENSORSHIP. A censor of plays, especially in Europe, is a person whose permission is necessary for the production of stage performances. A relic of the censorship of the press survives in Great Britain in the licensing of plays. By an Act of 1843, no plays may be acted for hire till they have been submitted to the Lord Chamberlain, who may refuse to license them in whole or in parts; the official who reads them for this purpose being the «examiner of stage plays.» A penalty of $150 attaches to the offense of acting an unlicensed or prohibited play; and the theatre in which it is represented forfeits its license. In the United States there is no general censor, but local authorities have power to forbid the representation of plays which they consider to be injurious to morality.

PLAY OF COLORS, *in mineralogy,* the rapid display of different colors on revolving a mineral. It is this property which adds so much to the beauty of the diamond (q.v.) and other gems. The play of colors in many gems is due to their high refractive and dispersive power. The magnificent play of colors of the precious opal was attributed by Brewster to microscopic cavities, but Behrends has proved that it is due to thin, curved lamellæ of the mineral, the refractive power of which may vary by 0.1 from that of the mass. These lamellæ are assumed to have been originally in parallel positions, but they were bent and broken in the solidification of the mineral.

PLAY GROUNDS. See Children's Play Ground; Recreation Centres.

PLAYA, plā'yą, mud deposits left by the drying up of temporary lakes in arid regions. They present a hard, barren surface, which shrinks and cracks under the sun's heat and in some instances becomes coated with efflorescent salts, resembling drifting snow. The Great Basin in the United States contains playa deposits of hundreds of feet in thickness. They are laid down by the desiccation during the dry season of large shallow lakes, known as sinks, holding in suspension a fine yellow silt, which form in the wet season. The deposits increase in depth by being thus intermittently covered by the silt-bearing water. Locally they are known by various names, such as mud-flats, salt-flats, alkali-flats, etc. The Black Rock Desert in Utah is an example.

PLAYBOY OF THE WESTERN WORLD, The, in three acts, by John Millington Synge, is a singularly arresting play by reason of its extraordinary combination of qualities that are ordinarily deemed contradictory. It is a comedy of Irish peasant life, extravagant, even boisterous at moments, yet based on the tragic theme of the murder of a father by his son; it is illuminated not only by the richest of humor but by poetic touches of poignant beauty, and all told in language so vivid and picturesque, so full of the zest and color of life, as to make ordinary English seem pale and tame,— «that vivid speech which has been shaped through some generations of English speaking by those who still think in Gaelic» (W. B. Yeats).

Christy Mahon comes to a lonely public house foot-weary, a stranger and a fugitive. The kindly curiosity of the tavern keeper, his daughter, Pegeen, and others, wrings from him the confession that he has killed his overbearing father in a fit of anger with a blow from a spade. This evidence of courage and overmastering passion in a seemingly gentle lad so impresses his hearers that they talk themselves, and him, into the conviction that he is a hero. Inspired by his new-found confidence he makes love to Pegeen in one of the most delightful love scenes ever written, and Pegeen is quite prepared to throw over her prosaic husband-elect for Christy. When Christy's old father turns up, at this juncture, not much the worse for his broken pate, it is quite natural that there should be a sudden revulsion of feeling against Christy. He has lost his hold on their imaginations, and poor Pegeen, her romance shattered, leads the pack against him. The ultra-Nationalists professed to regard the play as an attack on Irish morals and character and organized hostile demonstrations when ‹The Playboy› was first produced at the Abbey Theatre in Dublin in 1907, and later in London, and in the United States. In reality Synge has done the highest service to the Irish cause by creating dramas of artistic distinction and originality from purely Irish material. In his preface to the play Synge says, «I have used only one or two words that I have not heard among the country people of Ireland or spoken in my nursery.» Another quotation from Synge furnishes a most significant commentary on ‹The Playboy.› «On the stage one must have *reality* and one must have *joy;* . . . the rich joy found only in what is superb and wild in reality. . . . In a good play every speech should be as fully flavored as nut or apple, and such speeches cannot be written by any one who works among people who have shut their lips on poetry.» ‹The Playboy› is based on a story Synge heard in the Aran Islands; its language, its humor, its poetry, its flavor, its «reality,» its «joy,» are all drawn from Irish country folk and transmuted by the hand of the artist into an enduring work of art that is very human and very beautiful. For special references see article, Riders to the Sea.

Grace R. Robinson.

PLAYERS' CLUB, The, social organization in New York City, with commodious headquarters at 16 Gramercy Park. Membership in the Club is confined as far as possible to artists, editors, authors, playwrights, etc., but eminent lawyers and merchants are also eligible. The clubhouse was donated by Edwin Booth and was presented to the Club on 31 Dec. 1888. Nine directors, of whom five must be actors, playwrights or theatrical managers, manage the affairs of the organization.

PLAYFAIR, plŭf'fer, **John,** Scottish physicist: b. Benvie, Forfarshire, Scotland, 10 March 1748; d. Edinburgh, 19 July 1819. He was graduated from the University of Saint Andrews in 1765, entered the ministry in 1770 and held various livings, in the meantime devoting much time to mathematics; in 1785 he was appointed assistant professor of mathematics at the University of Edinburgh and in 1805 accepted the chair of natural philosophy there. He was secretary of the physical class in the Edinburgh Royal Society in 1789, subsequently general secretary and in 1807 was elected a member of the Royal Society. In 1815–16 he made a tour of France, Italy and Switzerland engaged in geological and mineralogical researches. He was a frequent contributor to the Endinburgh *Review* and his articles which are of great scientific value are collected in the 4th volume of the complete edition of his works edited by James G. Playfair (1822). He edited Euclid's 'Elements' (1705), and besides memoirs for the 'Transactions' of the Royal Society of Edinburgh, wrote 'Outlines of Natural Philosophy' (2 vols., 1812–16); 'Illustrations of the Huttonian Theory of the Earth'; etc.

PLAYFAIR, Lyon, Baron, British scientist and politician: b. Chanar, India, 21 May 1818; d. London, 29 May 1898. Educated at Saint Andrews, he also studied chemistry in Glasgow and began, but did not complete, the medical course at Edinburgh. After a brief period as a clerk in Calcutta he became laboratory assistant to Graham in University College, London, and in 1840 was graduated at Giessen, where he studied chemistry under Liebig. In 1843 he became professor of chemistry in the Royal Institution at Manchester and in 1858 professor of chemistry at Edinburgh, a post which he held till 1869. His political career began in 1868 with his election to the House of Commons as member of the universities of Edinburgh and Saint Andrews, which he represented till 1885, when he was elected for South Leeds. He became postmaster-general under Gladstone in 1873 and in 1880–83 was chairman and deputy-speaker of the House. In 1892 he was raised to the peerage as Baron Playfair of Saint Andrews. He published 'Science in its Relation to Labor' (1853); 'Primary and Technical Education' (1870); 'Science in Relation to the Public Weal'; and other works.

PLAYFAIR, William Smoult, English physician: b. 1836; d. Saint Andrews, Scotland, 13 Aug. 1903. He was educated at Saint Andrews and Edinburgh, was assistant-surgeon in the Bengal army in 1857 and professor of surgery at the Medical College, Calcutta, in 1859–60. He published 'A Treatise on the Science and Practice of Midwifery'; 'Handbook of Obstetric Operations'; 'A System of Gynecology' with Clifford Allbutt; etc.

PLAYING CARDS. See Cards.

PLAZA, plä'sa̤, **Leonidas,** Ecuadorean statesman: b. about 1868. He received his education at the University of Quito and soon was launched into a political career, becoming president of Ecuador in 1901. Because of his opposition to the clerical element his path was a difficult one; nevertheless he was successful in placing the Church under state control and otherwise curbing its activity in the country. He had been some time in retirement when Estrada died in 1911, whereupon Plazo tendered his services. Two years of internecine strife followed in which Plazo vanquished his principal opponents, Alfaro and Montero and again became president. He made earnest efforts to rehabilitate the state's depleted finances, to resume payments of the foreign debt and inaugurated extensive and rather ambitious sanitary improvements. He was greatly hampered, however, by continued revolutionary outbreaks.

PLEA AND PLEADING. A plea is a presentation of a cause of action, made in a court, frequently a special answer to a bill of equity, making a charge or demand and requesting a judgment of the court in the first instance on the ground that the plaintiff is debarred from an answer required by the bill — such, for example, as a plea to the jurisdiction of the court. In a broader sense, it is a formal statement of the position of either party to a suit at law, in some of the lower courts it may be made orally, but usually it is a carefully prepared document, if for the defense, denying the plaintiff's declaration, in whole or in part, or alleging new matter, as a cause for annuling the action. A plea may be pre-emptory, that is meeting the issue squarely, as by denying the allegations or it may be dilatory, raising some technicality to delay the case. A Court of Common Pleas is one in which such pleas are heard, in the United States being usually equivalent to a County Court.

Pleading, in law, is the act of presenting a plea; a logical legal statement of facts constituting the plaintiff's cause of action or the grounds of a defense. It is the formal manner of alleging, as far as may be sufficient, that which either party to a suit expects to prove. The object of pleading is to make the matter in dispute between the parties plain and intelligible. The whole system of legal procedure applicable to the presentation of a case is also termed pleading. It is an initial step in the trial of a case. The term «special pleading» is often applied to a pleading that alleges new matter. See Demurrer.

PLEASANTVILLE, N. J., city in Atlantic County, on the West Jersey and Seashore and the Atlantic City railroads, five miles north of Atlantic City. It contains several handsome public structures and residences and is becoming a favorite summer resort along that coast of many resorts. Pop. 4,390.

PLEASONTON, plĕz'ŏn-tŏn, **Alfred,** American military officer: b. Washington, D. C., 7 June 1824; d. there, 17 Feb. 1897. He was graduated from West Point in 1844; served on the frontier and in the Mexican War; in 1862 was commissioned major of the 2d Cavalry, served in the Peninsular campaign, was promoted brigadier-general of volunteers and in the Maryland campaign commanded a division of cavalry. At Chancellorsville he performed important service by staying the farther advance of the Confederates. In 1863 he was promoted major-general of volunteers and placed in command of the cavalry corps of the Army of the Potomac, with which he led at Gettysburg, where for gallantry in action he was breveted colonel in the regular army. Transferred to the West in 1864, he defeated General Price at Marais des-Cygnes and forced the retreat of the Confederate forces from Missouri. He retired from the volunteer service in 1866 and until 1871 was internal revenue collector and commissioner. During his military career he participated in 105 battles and at one time was tendered the command of the Army of the Potomac. In 1871 he became president of the Terre Haute and Cincinnati Railroad and in 1888 was placed on the retired list of the United States army.

PLEBEIANS, plẹ-bē'ạnz (*Plebs*), an order of the Roman people, corresponding to the English Commons. The time at which the Plebeians were recognized as a distinct order in the state is not known; they were at first excluded from almost every right of citizenship. They differed from the *Clientes* in not being obliged to choose a patron, were allowed to hold land, but had no share in the *ager publicus;* they were obliged to serve in the army, but were excluded from all political privileges. The government of the state belonged exclusively to the Patricians, with whom the Plebeians could not intermarry. This was their condition under the kings. The subsequent domestic history of Rome is merely a record of struggles of the Plebeians to assert their claim to the place in the commonwealth. When Tullus Hostilius conquered Alba, he admitted the chief of its citizens to the Patrician class, while the rest were enrolled as Plebeians. The same course was followed in other conquests, so that the number of the Plebeians was constantly swelling, while they were of the same blood and possessed of the same courage, determination and other moral qualities as the dominant class.

The Plebeians, like the Patricians, were divided into *gentes,* but they were excluded from the three Patrician tribes and from the *curiæ,* which formed the governing class. Tarquinius Priscus seems to have made an attempt to introduce the Plebeians to the privileges of citizenship, but was not successful. Servius Tullius organized the Plebeians in tribes, of which he constituted four for the city and 26 for the surrounding subject territories. Each tribe had a tribune. They had their own social and religious privileges and were allowed to meet in *comitia tributa* convoked by the tribunes. A semblance of political power was at the same time conferred on them by Servius Tullius. He divided the whole body of citizens into five classes according to the amount of their property, upon which division was founded the *comitia centuriata* or great national assembly, to which the greater part of the legislative and judicial power of the *comitia curiata* was transferred. The citizens, in this assembly, voted by centuries, but as the equestrian order and the first class of citizens had the majority of the whole number of centuries, and voted first, it was only in the case of differences among them that it was necessary to consult the lower classes. Some of the noble Plebeian families were also admitted into the equestrian order. To follow the entire course of concessions which followed this beginning would demand an examination of the most complicated details of Roman history. The establishment of tribunes (494 B.C.), the law of the 12 tables (451–450 B.C.), the Lex Canuleia (445 B.C.), which permitted intermarriage; the admission to the consulate (366 B.C.), with the successive admission in 351 B.C. to the censorship, 336 B.C. to the prætorship and 300 B.C. to the offices of pontifex and augur, were the leading steps in a succession of victories which culminated (286 B.C.) in the Lex Hortensia, which gave the plebiscita of the people the force of law. From this time the privileges of the two classes may be said to have been equal; the word *populus* now began to be used to designate the whole people and *plebs* were employed sometimes to designate the assembly of the *comitia centuriata,* or popularly to distinguish the general mass of the common people.

PLEBISCITE, a form of voting introduced into France under the Napoleonic régime, and named after the Roman *plebiscitum.* It was a vote of the whole body of voters ratifying some legislative enactment.

PLECTOGNATHI, an order of physoclistous fishes, having incomplete ossification of the skeleton. Hard bony plates or spines cover the tough integument. The filefishes, trunkfishes, globefishes and the like are examples. See FISH; ICHTHYOLOGY.

PLECTOSPONDYLI, an order of soft-rayed fishes represented by the suckers (*Catastomidæ*), carps, etc. See ICHTHYOLOGY.

PLECTRUM, a small instrument made of ivory, horn, quill or metal, with which (having it in his right hand) the player on a lyra or cithara sets the strings in vibration. Plectra are used by performers on the mandolin and zither, and serves the double purpose of saving the fingers from friction, and of avoiding the deadening of the tones that results from the soft touch of the human hand.

PLEDGE, or **PAWN,** a species of bailment, being the deposit or placing of goods as security for the payment of money borrowed, or the fulfilment of an obligation or promise. It is distinguished, in English law, from a mortgage of chattels by the circumstance that the legal property in the chattel mortgaged is in the mortgagee, whereas the legal ownership of goods pawned remains in the pawner, though according to the definition of a pawn and and pledge the pawnee not only has the right of possession, but must be in possession. If the money is not paid at the time stipulated the pawn may be sold by the pawnee, who may retain enough of the proceeds to pay the debt intended to be secured. It is impossible to pledge a thing not yet made, as a machine contracted for but not built. The business of loaning on pledges is generally subject to license, and each State of the United States makes its own laws governing the conditions. See PAWNBROKERS.

PLEHVE, plė-vĕ, **Viatcheslav Konstantinovitch,** Russian public official: b. 1846; d. Saint Petersburg, 28 July 1904. He received a legal training at the University of Moscow and in 1867 entered the Department of Justice. He was for a time public prosecutor at Saint Petersburg and in 1881 was promoted to director of the department of secret police under the direction of the Minister of the Interior. In 1884 Plehve became senator and 10 years later was appointed Secretary of State for Finland. He directed and executed the government repressive measures there and earned the lasting hatred and enmity of all lovers of liberty. In 1902 he became Minister of the Interior and by his harsh measures so fired the Revolutionists that they caused his assassination.

PLEIADES, plī'ą-dēz, the daughters of Atlas by Pleione, daughter of Oceanus. According to one version of their story they committed suicide out of grief for the death of their sisters, the Hyades; but another version makes the fate of their father (see ATLAS) the impelling cause. According to a third version, they were companions of Artemis, and being pursued by Orion (q.v.), were saved from him by the gods and translated to the sky. The versions agree in declaring that the Pleiades were transformed into stars, where they are all visible save one, Sterope, who hides herself for shame that she alone of the seven married a mortal (she being the «lost Pleiad»); her sisters are Electra, Maia, Taygete, Alcyone, Celæno and Merope.

PLEISTOCENE (plīs'tō-sēn) **EPOCH,** in geology, includes the time that elapsed between the close of the Tertiary and the dawn of the historical or recent period. Measured in years, it is the shortest of the epochs, but geologically it is one of the most interesting. It includes the great Ice Age during which glaciers advanced and retreated across vast areas in North America and northwestern Europe. It is also the epoch, during which, so far as can be determined by the available evidence, man first appeared on the earth. For these two reasons it has been more discussed. Being so recent it left much evidence, not yet obliterated, of changes of land and water areas, and of variations in climate; but the very abundance of the evidence increases the task of deciphering and summarizing it, since for remote epochs only the great changes are known through the evidence of the rocks.

It is fairly certain that at the close of the Tertiary great areas in northern North America and Europe were more elevated than now. North America and Asia were perhaps united across Bering Strait; similarly the British Islands were part of a European continent that stretched out from Norway toward Iceland and north of Russia and Sibera over areas now covered by the Arctic Ocean. Regarding the equatorial land areas less is known, but possibly North and South America were united and it is possible that the Desert of Sahara was in part at least covered by an arm of the ocean. Of the distribution of land and water in the Antarctic regions the evidence found is not conclusive, though it is probable that the Antarctic continent was of greater extent than now, with a land bridge from Australia to South America. How much higher the land areas toward the north in Europe and North America were is uncertain, but it is probable that the regions about Hudson Bay and northern Sweden and Norway were much higher. The climate of these areas at the time was generally drier and cooler than it had been during the late Tertiary. During the early Pleistocene river valleys were deeply carved and the topography was strongly accentuated. Gradually the climate in the Northern hemisphere became colder, and possibly moister. What produced this change is one of the most baffling problems in geology. In the course of years perennial snow stood on the higher ground and gradually accumulating formed vast ice sheets or glaciers which slowly advanced from these higher regions over the regions southward, and in the case of such mountains as the Alps, to northward. Thus began the great Ice Age which lasted thousands of years. The ice sheets advanced, retreated and advanced again. Some of the retreats must have been of long duration. In fact the evidence from rock decay and the formation of soils leads some geologists to believe that the time that has elapsed since the final retreat and disappearance of the great continental glaciers is not as long as that of some of the interglacial intervals. The probable number and succession of the glacial advances and retreats and the work done by the ice in modifying the topography of the glaciated regions are discussed elsewhere. (See GLACIAL PERIOD). At the end of the Ice Age the regions in the North that had been the center of glaciation were much lower than at its beginning and the climate was moister. A subsequent elevation and a drier climate make the conditions governing life what they are to-day. Outside the glaciated areas the changes of level and climate have left less trace.

The advances and retreats of the ice necessarily meant great changes in climate. During the advances Arctic types of plants and animals were forced southward, during the retreats other types migrated northward, the Arctic types retreating or finding refuge on mountain ranges. One result of these migrations was the extinction of types that could not migrate readily and in particular of the great mammals. Man when he appeared waged war upon the large land animals that had withstood climatic changes. Thus it is that with the dawn of the historical period the fauna of Europe and America was impoverished as compared with periods immediately preceding, and the huge pachyderms, which, through Tertiary time, had been so striking a feature of the animal population of what are now the temperate regions of the world, disappeared, leaving only their gigantic remains to tell modern man the kind of monsters that have been the contemporaries of his prehistoric progenitors. See also QUATERNARY.

PLEKHANOFF, plė-kän'ov, **George,** Russian political economist; founder of the Russian Social-Democracy: b. 1857; d. Petrograd, June 1918. He was of noble origin, attended the Petrograd School of Mines, and at an early age joined the Populists (*narodniki*), later the *Zemlya i Volya* (Land and Liberty) Group. When the party split in the 70's, he stood at the head of the *Chorny Peredyel* (Black Division). In 1880 he was forced to seek refuge in western Europe and became contributor to *Narodnaya Volya* (*People's Liberty*), but his aversion to Blanquism brought him back to the field of Marxist thought. In 1883, while in France, and later while living in Switzerland, together with Axelrod and others, he was actively agitating for the foundation of a Russian Social-Democratic Party, which from the start was dominated by the teachings of Karl Marx. His early pamphlets were 'Socialism and Political Action' (1883), 'Our Differences' (1884), and a translation and introduction to the 'Communist Manifesto.' (See KARL MARX). Plekhanoff's chief accomplishment in this period was an elucidation of the differences between Socialism and Anarchism, and a strong opposition to the latter. He was also opposed to the theory that the Russian people were better prepared for the Social Revolution than others because of their traditional agricultural communism and proved from the writings of Marx and Engels that this would not obviate the necessity of passing through the stage of Capitalism to Socialism. «Seizures of power», such as all Russian revolutionists since the days of the Decembrists considered possible, he regarded as foredoomed to failure owing to the lack of preparation on the part of the masses. Such seizure of power, he taught, could be undertaken only by a thoroughly trained working class. In the 90's Plekhanoff began to acquire a more international reputation, through his scientific economic studies, in defense and elaboration of the doctrine of economic determinism. His 'Contributions to the History of Materialism' places him at the head of those Marxists who would relate historic materialism closely with the physical sciences, and his book on Chernishevsky made western Europe aware of the existene of this great Russian thinker. The famous schism in the Russian Social-Democracy between *bolsheviki* and *mensheviki* took place in 1903, and Plekhanoff at once joined forces with the latter; but after the Revolution of 1905 he was embroiled with his former associates. He was now outside of both factions, and this situation was emphasized further by the outbreak of the War in 1914. Plekhanoff became a patriot and insisted on the necessity of a victory of the Entente Powers over the Central Empires, and therefore of supporting the government of the Tsar in the war. He therefore found himself, on his return to Petrograd from Switzerland (where he had spent all the years of his maturity), after the Revolution of March 1917 at variance with both mensheviki and bolsheviki, and was able to retain leadership only of the small Yedinstvo (Unity) Group, which had practically no influence on the course of the proletarian revolution which came into power in November 1917. The last few months of his life were no doubt embittered by the opposition of the entire working class population of Petrograd, which, weary of long months of hardships, was eager for a termination of the war, which consummation Plekhanoff was actively resisting, going so far as to ally himself with the Cadet Party and the military and bourgeois organizations in the pursuit of this end.

JACOB WITTMER HARTMANN.

PLEOCHROISM. See PHYSICAL CRYSTALLOGRAPHY.

PLESIOSAURUS, a genus of extinct reptiles of the order *Sauropterygia.* Several species have been described from very complete remains in European Lias rocks, first discovered in 1822 and studied by Cuvier and his followers. In these reptiles the head is small, the neck very long, the tail of moderate length. The typical species is *P. dolichodirus,* about 10 feet long; allied species are sometimes found 25 feet long. There is a fine skeleton preserved in the Berlin Museum, classified as *P. guilelmi imperatoris.* Over 25 species have been recognized in the Liassic seas of England, and they are also common in the continent of Europe. In the United States related species have been located in the Upper Jurassic and Upper Cretaceous. One of these uncovered at Fort Wallace, Kans., and known as Cope's *Elasmosaurus* had a neck 22 feet long and a total length estimated from the incomplete skeleton of at least 42 feet. These monstrous lizards swallowed stones like modern fowl, to aid their digestion. Their food was undoubtedly fish, as their dentition was adapted to grasping and tearing. It may reasonably be inferred that these reptiles were aquatic and inhabited the estuaries of rivers and shallow waters, occasionally swimming out to sea. Their gait on land would necessarily be awkward and difficult. The elongated neck would serve to enable them to descry their prey from among or over the tops of the reeds and vegetation amid which they might lie concealed in the banks of rivers or in estuaries, while this same length of neck would adapt them for readily seizing their prey, which consisted probably in greater part of fishes. Some have thought that a few remain, and that their long necks and small heads have caused them to be taken for swimming serpents, thus accounting for the ever-recurring accounts of sea-serpents. Consult for particulars of structure Woodward, 'Vertebrate Paleontology' (1898); and Williston, S. W., 'North American Pleiosaurs' (in 'Field Columbian Museum Publication 73,' Chicago 1903).

PLESSIS, plĕ-sē, **Joseph Octave,** Canadian Roman Catholic bishop: b. near Montreal, province of Quebec, 1763; d. Quebec, Canada, 4 Dec. 1825. He was educated at the Petit Séminaire, Quebec, taught belles-lettres and rhetoric at the College of Montreal, was ordained in the priesthood in 1786, and soon afterward became secretary to Bishop Hubert. In 1792 he was appointed curé of Quebec, and later became coadjutor to Bishop Denault, despite the opposition of the governor of the province, who feared the influence of Plessis with the French Canadians, and in 1806 succeeded Bishop Denault in the see of Quebec. An effort made to introduce an exclusively Protestant system of instruction, and an attempt to prevent his taking the oath of allegiance as bishop resulted in the recall of Governor Craig. Sir George Provost was appointed in his stead, and the demands of the bishop were conceded. During the War of 1812 the bishop loyally supported the English, and thereby gained the favor of the government, he was then recognized in his office of bishop, granted a seat in the legislative council, and was pensioned. In 1818 he was nominated archbishop of Quebec. Consult 'Life' by Ferland (1864).

PLETHO, surname of Georgios Gemistos (often called Gemistus Plethon) Byzantine scholar and philosopher of the 14th and 15th centuries: b. Constantinople. For many years he was the head of a philosophical school at Misithra in the Peloponnesus. He went with the Emperor John VIII, Palæologus, to the council at Ferrara, and remained until 1441 in Italy, where he gave great impetus to Greek studies, and was the means of establishing the Platonic Academy of Cosmo de' Medici. His treatise in praise of Platonism inaugurated the long quarrel between the disciples of the two great masters of antiquity, which produced a profound study of their systems. Pletho, however, mingled with the Platonic philosophy the notions of the later Alexandrian school and of the spurious writings attributed to Zoroaster and Hermes. The best collection of his writings is in Migne's 'Patrologia Græca' (Vol. XIX, Paris 1866). Consult Schultze, 'Pletho, und seine Bestrebungen' (1874).

PLETHORA, or HYPERÆMIA, a condition of overfulness of the blood-vascular system, a condition in which there is obvious excess of blood in the body. It can hardly be called a disease. That is to say, the quantity of blood may be in excess of the normal, but its quality may be unaltered. On the other hand, there is a condition of plethora, called by pathologists hydræmic plethora, in which there is not only excess in the total volume of blood, but the excess is due to retention of water, so that the blood is more watery than usual. But the term plethora as ordinarily used signifies simply excess of blood.

Amputation is a frequent cause of plethora, as the digestive powers do not immediately accommodate themselves to the reduced wants of the system, and too much food is liable to be taken and too much blood formed. Plethora has two leading causes — the introduction into the vascular system of too much nutriment, and the deficient activity of tissue-change in the various organs, whereby the nutritive matter is insufficiently removed from the blood. A tendency to plethora thus generally develops at an advanced age, when the activity of tissue-processes has been considerably diminished. Plethora is often confounded with obesity, from which it is quite distinct. Plethoric persons, however, are usually unduly stout, much of the excess of nutritive material being deposited as fat under the skin. Plethora produces a diminution of activity and a greater tendency to sleep than belongs with health; these symptoms increase as it becomes aggravated, and culminate in lassitude and vertigo, turgid countenance, suffused eyes, palpitation of the heart, and similar phenomena. The treatment of plethora is entirely negative, and is suggested by the causes of the disease. Abstinence and exercise are its two most important elements, and their combination depends upon the circumstances of the individual case. Generally abstinence from malt liquors, wines or spirits is recommended.

PLEURA, the serous membrane lining the cavity of the thorax or chest, and which also covers the lungs. Each lung is invested by a separate pleura or portion of this membrane; the structure being spoken of rather as double pleuræ than as a single membrane. Like all serous membranes, each pleura is a completely closed or shut sac, and does not communicate with its companion membrane; and it further resembles the other serous membranes in that one side or part of the sac lines the containing cavity, while the other part or fold is reflected over the contained organs. In the thorax, therefore, each pleura is found to consist of a portion lining the walls of the chest, this fold being named the *pleura costalis* or parietal layer of the pleura. The other fold, reflected upon the lung's surface, is named in contradistinction the *pleura pulmonalis*, or the visceral layer. These two folds enclose a space known as the pleural cavity, which in health contains serous fluid in just sufficient quantity to lubricate the surfaces of the pleuræ as they glide over one another in the movements of respiration. In front the two pleural sacs touch one another at a single point only, about the middle of the sternum, and they therefore enclose a space between them known as the mediastinum, which is again divided into anterior, middle, posterior portions. In the mediastinal space the heart and other organs of the chest, excepting the lungs, are situated. The pleura lines the ribs laterally, and a portion of the sternum or breast-bone in front. From the breast-bone it passes backward over the pericardium. The pleura of the right side is wider, shorter and extends higher in the neck than that of the left side. The outer aspect of the membrane adheres to the lung-surface, and also to the pulmonary vessels as these leave the pericardium. It is also attached to the diaphragm below; elsewhere it is but loosely connected to the contiguous surfaces. It is supplied with blood vessels from the internal mammary, intercostal, phrenic and other arterial trunks; its veins corresponding in nature to the arteries. Its nervous supply is derived from the phrenic and sympathetic nerves, while the absorbent or lymphatic vessels are also numerous.

The diseases to which the pleuræ are subject are chiefly pleurisy or inflammation of the membrane; pneumothorax, with or without effusion of fluid into the pleural cavity (hydrothorax), and empyema. Hæmothorax, or blood in the pleural cavity, generally results from accidental wounding of the intercostal arteries. Inflammation of the pleura of itself may terminate in hydrothorax or empyema, the inflammatory products in this, as in other cases, appearing in the form of serous fluid or pus respectively. See PLEURISY.

PLEURISY, an inflammatory disease of the pleura (q.v.). It is either dry or accompanied by effusion. Dry or fibrinous pleurisy is characterized by an inflamed area, usually of small extent, covered with a layer of plastic lymph and somewhat roughened. Its invasion is accompanied with sharp pain and a dry cough, and friction-sounds are heard on placing the ear to the chest. Adjacent portions of the membrane may adhere together, forming adhesions which become permanent and limit the movements of the lung. Pleurisy is usually due to cold, unless secondary to another disease, such as penumonia, tuberculosis or cancer. Frequently an arrest of the inflammatory process occurs, and the fibrinous layer disappears from the surface of the pleura by absorption. If not, there may be an effusion of serum into the space between the two layers of the pleura. The amount of effusion may be so great as to cause serious displacement of the lung or heart. If small in amount the fluid is often reabsorbed; but otherwise it must be removed by tapping. The fluid at first is pale and yellowish, or stained with blood-pigment. Later it becomes turbid, and if it becomes infected by bacteria carried into the pleura by the lympathics, or entering through a penetrating wound or during the progress of malignant disease or tubercle, it is converted into purulent matter. The condition is then termed empyema, or chronic purulent pleurisy, and is grave. The pus may penetrate the wall of the pleural cavity and the lung-tissue and burst into a bronchial tube and be coughed up. Or it may perforate the diaphragm, enter the peritoneal cavity and cause a purulent peritonitis. Few cases recover without surgical treatment which consists of opening the suppurating cavity and providing drainage.

In all pleurisy breathing is apt to be shallow and difficult, and general weakness, loss of appetite, headache and rapid pulse are noted. When pus appears in a pleural cavity there is an irregular temperature, a succession of chills and recurrent sweats. Upon the entrance of fluid into the pleura the friction-sounds disappear, and a dullness and later a flatness is ascertained by percussion over the position of the effusion. Wet or sero-fibrinous pleurisy may continue for months, and the compressed lung may never expand again to its former volume, but may become «carnified.» Tuberculous pleurisy occurs as a result of tuberculosis of the lung, in a vast number of cases, as a primary disease. As a secondary implication, dry pleurisy always occurs when the tubercular process reaches the surface of the lung. Hemorrhagic pleurisy, or pleurisy with a bloody effusion, occurs frequently in cases of cancer, Bright's disease and certain fevers, as well as in tuberculosis.

According to the situation of the lesion, pleurisy is termed diaphragmatic or interlobular. When limited by adhesions which form pockets, it is termed encysted. In the treatment of pleurisy little medicine is used. A cathartic is desirable at the outset. Adhesive-plaster straps are employed, fastened around the chest, or half of it, to secure immobilization of the affected side. An ice-bag gives relief from pain and limits the inflammation. Counter irritation may be secured with iodine or mustard, but blisters and cups are now seldom employed. Vapor baths, to cause diaphoresis, and diuretics are rarely required. Salicylates are useful in some cases. Aspiration of the fluid is secured by means of a hollow needle to which a suction-pump is attached, a method invented and introduced by Wyman of Cambridge and Bowditch of Boston. The needle is inserted generally in the axillary line and the operation is practically without risk. The fluid is withdrawn slowly, and even as much as a quart may be removed with safety. Often after a small fraction of an effusion is removed the remainder will be absorbed spontaneously. In cases of empyema a free incision is usually made and open drainage secured. Sometimes it is necessary to reset a part of one or two ribs. After recovery from empyema the chest is usually sunken and flattened.

PLEURISY-ROOT, a perennial herb of the genus *Asclepias* (q.v.).

PLEURONECTIDÆ. See FLATFISH.

PLEUROPNEUMONIA, a disease common to cattle, and occasionally communicated to other domestic quadrupeds. It is highly contagious, and exceedingly fatal, though a certain proportion of animals recover. It first manifests itself in a morbid condition of the general system; but its seat is in the lungs and the pleura, where it causes an abundant inflammatory exudation of thick plastic matter. The lungs become rapidly filled with this, and the animal suffers from cough and difficulty in breathing. Many die in the course of a few days. It is believed to have been wholly eradicated in America and Europe. Consult Atkinson, V. T., 'Special Report on Diseases of Cattle' (Bureau of Animal Industry, Washington 1912). See CATTLE-PLAGUE; RINDERPEST.

PLEVNA, plĕv'nạ, or **PLEVEN,** Bulgaria, the chief town of the district of the same name, about four miles east of the Vid, a tributary of the Danube. Plevna commands a number of important roads, hence is a place of some strategical importance. It is noted for the gallant resistance of its Turkish garrison under Osman Pasha to the Russians during the Russo-Turkish War of 1877–78. Osman intrenched himself here in the early part of September, and the Russian attempts with superior forces to take the place by storm were failures. When food and ammunition had run short he made a bold effort to cut his way through his enemies, but was compelled to capitulate with 40,000 men (10 Dec. 1877). The Russians had to assemble a force of 100,000 men and starve the garrison before victory was accomplished. The area of the district is 1,851 square miles; population, 365,858; city population, 23,049. Consult Herbert, W. V., 'The Defense of Plevna' (London 1896).

PLEXIMETER. See PERCUSSION.

PLEYEL, plī'ĕl, **Ignaz,** Austrian composer: b. Ruppertsthal, near Vienna, Austria, 1 June 1757; d. Paris, France, 14 Nov. 1831. He studied composition under Haydn, and in 1786 made a tour through Italy and France, where he was everywhere received with the greatest favor. In 1787 he was appointed chapel-master to Strassburg cathedral; but in consequence of the revolution he was obliged to flee. He proceeded to London; became again connected with Haydn, and gave a series of concerts in 1791–92. He soon after went back to France, and at a later period founded a musical business and piano factory which became one of the most important in Europe. In 1801 he commenced editing the 'Bibliothèque Musicale,' in which he inserted the best works of the Italian, German and French composers. His own works, chiefly instrumental pieces, are light, pleasing and expressive. The earliest of them are the best. One of the most popular is the well-known hymn tune which bears his name.

PLICA, PLICA POLONICA, or TRICHOMA, a condition formerly regarded as a disease, indicated by a matting of the hair of the head or body, in which the hair becomes agglutinated by a nauseous exudation from the roots, the bulbs become enlarged, and the hair swells and becomes soft. Plica is said to have appeared in Poland and adjacent districts about the end of the 13th century, and is now gradually wearing out. The condition is usually kept up by neglect, being deemed a safeguard against some internal disease, and no means being taken to remove it. The treatment of plica is for the most part empirical, and beyond cleanliness and attention to diet there appears to be nothing in regard to it determined with certainty.

PLIMSOLL, plĭm'sŏl, **Samuel** («THE SAILORS' FRIEND»), English reformer: b. Bristol, 10 Feb. 1824; d. Folkestone, Kent, 3 June 1898. Through his occupation as a coal dealer he became interested in the condition of sailors, and the dangers to which they were exposed by unscrupulous overloading of heavily insured vessels induced him to enter Parliament in 1868 as member for Derby. In 1873 he published 'Our Seamen,' which succeeded in its purpose of arousing public attention, and in 1876 the Merchant Shipping Act, embodying many of his demands, was passed. Among its provisions was the load line known as «Plimsoll's line,» which has since been marked on all English ships. He also wrote 'Cattle Ships' (1890), with reference to securing reform in that direction.

PLINLIMMON, plĭn-lĭm'mŏn, **PLYNLIMON**, or **PUMLUMON**, Wales, a mountain-mass on the boundary between the counties of Montgomery and Cardigan, 10 miles west of Llanidloes. It has three principal summits (although the name means «five beacons»), attaining a maximum altitude of 2,468 feet. The Severn and the Wye rivers rise on its slopes.

PLINTH, in architecture, the lower square member of the base of a column or pedestal. In a wall the term plinth is applied to two or three rows of bricks which project from the face. See ARCHITECTURE; COLUMN.

PLINY, plĭn'y (GAIUS PLINIUS SECUNDUS), commonly called Pliny the Elder, Roman author: b. Novum Comum, 23 A.D.; d. Stabiæ, 79 A.D. He came to Rome at an early age where he availed himself of the best teachers. He served in Germany under Domitius Corbulo and Pomponius Secundus, and obtained the command of a troop of cavalry. During the intervals of his military duties he composed the treatise 'De Jaculatione Equestri,' and began a 'History of the Germanic War,' which he subsequently completed in 20 books. Apparently he fought in the Jewish war and was made procurator of Syria. It is known that he was also appointed procurator of the emperor in Spain. His nephew, Pliny the Younger (q.v.), has left an account of his life at this period, which was one of constant study. He made extracts from all the books he read, or had read to him, and at his death left his nephew 160 volumes of these notes. His 'Natural History,' compiled from materials accumulated in this way, was published about 77. This is his only extant work. He perished in the eruption of Mount Vesuvius which overwhelmed Pompeii and Herculaneum in 79. The 'Historia Naturalis' is divided into 37 books, and is, according to his own account, a compilation from upward of 2,000 volumes. It embraces the domain of natural history in the widest sense, including astronomy, geography and meteorology. It even goes beyond what natural history in any sense would include — treating of the fine arts and human institutions and inventions. The first edition was published at Venice in 1469. The edition of Hardouin 1685 is the first critical edition. The edition of Panckouke (1829–33), with a French translation, and notes by eminent modern naturalists and scientific men, including Cuvier, is of great value. The best editions of the text are those of Sillig (1851–58) and Detlefsen (1866–73). Pliny was translated into English by Philemon Holland (1601, two vols. folio). There is a translation (1855) in Bohn's Classic Library by Bostock and Riley. Pliny has been the chief source from which historians have obtained color and detail to embellish their descriptions of life at the opening of the Christian era. While his accumulations were not scientific in the modern sense, and while he did not have the trained sense of a modern encyclopedist, yet he was an indefatigable worker, and has passed on to the modern a vast amount of early erudition which otherwise would have been lost. Consult Mayhof's republication of Jan's 1875 edition of Pliny's works (1909).

PLINY (GAIUS PLINIUS CÆCILIUS SECUNDUS), called Pliny the younger, Roman author: b. Novum Comum, 62 A.D.; d. about 113. He was a nephew of Pliny the Elder, by whom he was adopted and carefully educated. He studied at Rome under Quintilian and Nicetes Sacerdos, in 76 wrote a work in Greek — «What it was I know not; it was called a tradegy» — and in 81 made his first appearance as an advocate by pleading a case before the centumviri. After service in Syria as tribune of the third legion, he entered public life, becoming successively quæstor Cæsaris (emperor's quæstor; 87), tribune of the plebs (91), and prætor (93). He was then forced by the conditions of Domitian's government to withdraw from his office; and the discovery among Domitian's papers of a charge of treason against him makes it evident that his life was saved by the tyrant's assassination (96). In September 100 he became consul (with Cornutus Tertullus). Trajan, with clear appreciation of Pliny's administrative talents, made him augur (104 or 105), and later curator of the channel and banks of the Tiber and of the municipal drainage system. He was sent out in 111 as governor with special powers of the province of Bithynia. His official correspondence with the emperor ends in 113; and he then disappears from view. His miscellaneous letters are the best extant contemporary authority for an important period of Roman history. Those to and from Trajan afford the chief documentary evidence for the study of Roman provincial government; and they contain, also, the earliest information *ab extra* of the manners of the primitive Christians and their official treatment by the Roman administration. Through the extent and variety of his own works, supplemented by inscriptions discovered at Novum Comum, Pliny is perhaps more fully and accurately known than any ancient writer save Cicero. His letters, however, unlike those of Cicero, were evidently written and arranged for publication. The order is largely chronological, although, to give an impression of carelessness, slight deviations appear within the individual books. The diction is clear and smooth; and if, as Simcox thinks, his «boundless self-complacency found here a safe opportunity for expansion,» there is also manifest throughout a certain tone of culture and distinction which quite reconciles to any such quality. Of Pliny's verses nothing remains and of his published speeches only a fulsome panegyric on Trajan whose florid style probably represents his oratorical attempts to imitate Demosthenes. The best edition is that of Keil (1873), who established the text and was aided by Mommsen. There are also many other excellent editions in whole or in part. There is an English version of the letters by Lewis (1880). Consult also Church and Brodribb, 'Pliny's Letters (1872) in Collins' 'Ancient Classics for English Readers'; and Schanz, Martin, 'Geschichte der Römischen Litteratur' (Munich 1913).

PLIOCENE, according to Geological Survey usage, the latest epoch of the Tertiary period. It is preceded by Miocene, and followed by Pleistocene. Some authorities give it the rank of period. During this epoch the continent of North America had very nearly the same outline as at present, though a very narrow strip of marine beds on parts of the Atlantic and Gulf coasts show that at least for part of the epoch the sea had encroached on the land. Florida was largely under water. A narrow belt of marine beds also exists on the Pacific Coast. Rather general uplift of the continent took place near the close of Pliocene time. The connection with South America, broken during Eocene (q.v.) time, was re-established during the Pliocene, with a resultant mingling of the faunas. The life of the epoch was not greatly different from that of modern times. The horse, which originated in the United States, had developed to its present genus. The rhinoceros, the mastodon and the sabre-toothed tiger were all present, though they ceased to exist on this continent during the Pleistocene. In Java, a skeleton has been found in Pliocene rocks, that may possibly represent an ancestral man. It has been called Pithecanthropus erectus (q.v.).

PLIOHIPPUS. See HORSE, EVOLUTION OF.

PLIOSAURUS. See PLESIOSAURUS.

PLOCK, plŏtsk, or **PLOTZK**, places in Poland, (1) town, capital of the government of Plock, on the right bank of the Vistula, 60 miles northwest of Warsaw. It has no less than 25 squares, of which one in the old town is very regularly built. It has a handsome cathedral, a considerable trade and several large fairs. Pop. (1915) 35,190. (2) The government of Plock has an area of 3,641 square miles of level and moderately fertile territory. It was overrun by the Germans during the World War and sadly damaged. The region is agricultural; wheat, rye and oats are grown and milled; there is a considerable beet-sugar industry. Lumber is cut and shipped. The Vistula is the principal river, but the Drewenz, which forms part of the northern boundary with Prussia, is a stream of good size. Pop. 786,000.

PLOMBIERES, plăṅ-bē-âr, France, a health-resort in the department of Vosges, 14 miles south of Epinal. It became fashionable during the Second Empire through the favor of Napoleon III, though the virtues of its waters were known ever since the times of the Romans. There are nearly 30 springs, ranging in temperature from 66° to 150° F.; their waters are in great repute against skin diseases, gout, rheumatism, dyspepsia, female complaints, etc. A handsome casino was opened in 1876, and there are picturesque walks and a park in the valley in which the village stands. Permanent population about 2,000.

PLOTINUS, plō-tī'nūs, the most famous of Neo-Platonists: b. Lycopolis, Egypt, about 204 A.D.; d. Minturnæ, Campania, 270. In his intercourse with his pupils and acquaintances he avoided all reference to the antecedent circumstances of his life, his age, nativity or parentage. It is conjectured that he was of Roman descent, probably a freedman. It was in his 28th year that the desire to study philosophy awoke in him. He then fell into great despondency and was brought by a friend to Ammonius Saccas, a Christian, who had written some works on Christian theology, but returned to the Hellenic faith. He remained with him some 10 years. In 242 he joined the expedition of the Emperor Gordian to the East, in order to learn the philosophy of the Persians and Indians. After the death of Gordian he went to Rome where he subsequently lived and taught. About 254 his friends induced him to put his doctrines in writing. The works of Plotinus were highly valued by Longinus, although that philosopher was in no sense a Plotinist, and are distinguished by energy and enthusiasm. He was in fact a preacher. His teaching secured him great respect and popularity among those who did not receive Christianity. Parents left their children to his care, and his house was full of orphans of both sexes entrusted to his guardianship. Although neglectful of his own temporal interests, he showed no want of shrewdness in looking after the estates of his wards. Plotinus enjoyed the favor of the Emperor Gallienus, from whom he obtained the privilege of rebuilding at the expense of the government two destroyed towns in the Campania, with a view to their being governed according to the laws of Plato. Plotinus was one of the great masters of philosophy. The value of his system depends less upon the intrinsic truth it contains than upon its historical importance and its adaptation to a certain class of human sympathies. The historical value of the system, great both in its antecedents and consequents, is due partly to the circumstances out of which it arose and partly to the genius and originality of its founder. It had its source at the junction of two independent streams of thought; mysticism and dialectics, which, already fortuitously united, received a new direction from the individual energy of the mind of Plotinus. He was well acquainted with the older Greek philosophy, the Ionian and the Eleatic schools, etc., and according to the eclectic tendencies of his day believed there was a fundamental unity in these various systems. It was to Plato, however, that he looked as his great authority. He believed himself a strict follower of Plato; uses Plato's term, the Good, for his highest generalization; but with Plotinus it is an abstraction from which every determinate quality has been eliminated and would rather be described in modern philosophical language as the Absolute. Consult Jones, Rufus M., 'Studies in Mystical Religion' (1909); Guthrie, K. S., 'The Philosophy of Plotinus' (1910); Inge,

W. R., ‘The Philosophy of Plotinus’ (2 vols., London 1918).

PLOTZ, plätz, **Harry**, American bacteriologist: b. Paterson, N. J., 1890. In 1913 he was graduated at the College of Physicians and Surgeons of Columbia University and in 1914 discovered the bacillus of typhus. He subsequently proved the identity of Brill's disease with typhus and in 1915 he brought out a vaccine against typhus. The authorities of Mount Sinai Hospital sent him to Serbia in 1915, with a complete vaccination apparatus, in an effort to stem the tide of the typhus epidemic then raging in that country.

PLOVER, the general name employed to designate most birds of the limicoline family *Charadriidæ*, of which the true plovers are sometimes held to constitute the subfamily *Charadrinæ*, and to that extent are separated from the turnstones and surf-birds (qq.v.). Closely related are the sandpipers and snipes (qq.v.). The plovers have a short or moderate bill, never exceeding the head, soft basally, but horny, somewhat enlarged and usually slightly hooked at the end. The legs are comparatively short and, with only a few exceptions, have no hallux, and the three remaining toes are not much lengthened. The body is full and plump, the neck short and thick and the head large. The long pointed wings reach to the tip of the short, 12-quilled tail. Plovers are small or moderate sized birds, remarkable for their extensive migrations and found along the seashore or in plains and fields. They are strictly ground birds and with few exceptions lay four speckled pyriform eggs in a slight depression in the ground. About 75 species are known from all parts of the world, some of the exotic ones exhibiting remarkable modifications. Within the limits of North America there occur three genera and 13 species, all closely related. The most distinct of these is the lapwing (*Vanellus vanellus*), known by its crested head and long overlapping wings, a rare straggler from Europe which scarcely belongs to our fauna. To the genus *Charadrius* belong the black-bellied or bull plover (*C. squatarola*) and the golden plovers (*C. dominicus*), *et al.* The former is nearly a foot long, and in the breeding plumage has the under parts largely black, but in the autumnal plumage, as usually seen in the United States, the black is limited chiefly to the axillary region. This plover may be distinguished at once from any closely related American species by the presence of a distinct hind toe. It breeds in the far north sparingly as far south as Minnesota, and undertakes the most stupendous migrations, reaching South American on our side and South Africa, Australia and Tasmania on the other. It migrates in flocks both coastwise and in the interior; and is equally common in this country and Europe where it is called the gray plover. The American golden plover (*C. dominicus*), also known to gunners as the field plover and bull-head plover, is only slightly smaller than the last, from which it is easily distinguished by the absence of a hind toe and the paler finely mottled plumage, the upper parts of which have much golden-yellow in summer. This species breeds in Arctic America and winters as far south as Patagonia, passing through the United States as a transient in the spring and again from August to November. At the latter season their numbers are augmented by the young of the year, and they migrate in great flocks or waves which often linger for several weeks in neighborhoods where food is abundant. Consult Elliot, ‘North American Shore Birds’ (New York 1895); Sandys and Van Dyke, ‘Upland Game Birds’ (New York 1902); Murphy, ‘American Game Bird Shooting’ (New York 1882); besides the standard works on ornithology.

PLOW, an implement originally drawn by horses, oxen, etc., used for breaking up or loosening the soil, preparatory to planting or sowing. The plow was the primary implement of civilization. The cultivation of the soil, which began with the invention of the plow, made it possible for men to live in permanent, populous communities, and civilization found a foothold wherever the pastoral tribes of the Stone Age learned the lesson of industry by following the plow. According to an Egyptian legend, «Osiris taught the way and manner of tillage and good management of the fruits of the earth.» It was undoubtedly in the valley of the Nile, or the Euphrates, that the plow was invented, for in these valleys are found the oldest ruins of agricultural settlements.

The first plow was roughly fashioned from a forked tree. One branch served as the beam, while the other branch was cut off and pointed, and the tail was trimmed to form a handle. Plows of this crude type are pictured on Egyptian monuments. After bronze tools came into use, it was possible to make a more finished and efficient plow of dressed timbers, and many variations are found in the forms of wooden plows that were used 2,000 to 4,000 years ago. In the prevailing type, a block of wood, with the front end pointed or wedge-shaped, served as the bottom, to which the beam and a single handle were attached. In Latin America, and in many other parts of the world, wooden plows of this form, with iron points and one handle, are in use to this day. The extension of agriculture and civilization in Europe awaited the introduction of iron for plow points, which occurred shortly before the Christian era.

The ancient plow merely stirred or loosened the soil. Modern plows cut a furrow and turn it over so as to cover the sod and weeds, and leave fresh soil on the surface as the seed bed of the crop that is to be planted or sown. English and American patent records show the evolution, in the past two centuries, of the modern form of plow. The Colonial plow, which was used in the United States until the beginning of the 19th century, reflects English ideas in plow-making. The point was of wrought iron, sometimes tipped or edged with steel. The moldboard and all the other parts were of wood, but in some cases the moldboard was covered with sheet iron.

In 1797 Charles Newbold, of New Jersey, patented a cast-iron plow in which the share and moldboard were cast in one piece, but this plow did not prove successful, as the cast-iron point would soon wear off, and farmers could not afford the cost of renewal of so large and expensive a casting. The most practical improvement of this period was made by Richard B. Chenaworth, of Baltimore, one of the first manufacturers of farm implements in the United States, who patented, in 1813, a cast-iron plow in which the share, moldboard and landside were cast in separate pieces. Jethro Wood, of New York, who took out patents in 1813 and 1819 on improvements in cast-iron plows, has been given credit for important work in the introduction of improved plows, although the main feature of his patent of 1819 was not a practical invention. He never engaged in manufacturing, and was unsuccessful in obtaining any income from royalties or licenses under his patents, but he gave his entire life to the work of advocating the use of cast-iron plows.

To James Oliver, of South Bend, Ind., is due the credit for the invention of the chilled plow. He began the manufacture of plows at South Bend, Ind., in 1855. When iron is cast in a chill, that is, in a mold one side of which is a metal vessel filled with water, the sudden cooling of the molten iron in contact with the chill gives the casting a surface as hard as the hardest steel. But the chilled metal was not strong enough to stand the hard usage that a plow receives in the field, and it was impossible to prevent flaws and blow holes in the broad face of a moldboard. After many years of effort, Mr. Oliver mastered the problem. His first success was obtained in chilling the wing or outer end of the moldboard, where the friction with the soil is greatest and he ultimately succeeded in this purpose by the use of three inventions. The first consisted in the use of a chill filled with hot water. The heat dried out the moisture of the sand in the mold, and this obviated the flaws and blowholes that were caused by steam, which had been generated when the molten metal was poured into the mold. The next invention was the ventilation of the chill by means of checkered grooves on its face, which permitted the air and hot gases from the metal to escape from the mold. These two inventions produced a chilled casting which was free from flaws, but moldboards cast in this manner were not strong enough to stand ordinary usage in the field. This last difficulty was overcome by the invention of an annealing process which tempered and strengthened the moldboard without detracting from its wearing and scouring qualities and made the chilled plows a complete success.

A few of the notable improvements that have been patented by James Oliver are: The cast share, with chilled point and cutting edge, made by a simple process; the share with an upward, coulter-like extension, which fits against the front edge of the moldboard and gives a new vertical cutting edge to the plow when the share is renewed; the curved malleable standard, which brings the beam over the line of resistance of the plow; the simple adjustment of the beam, which makes the plow balance perfectly with two or three horses; the malleable gauge wheel, which regulates the depth of the furrow; and other devices to simplify and improve the work of the plow.

The next improvement in plows was the sulky or buggy plow, having two wheels and a seat, also a lever for regulating the depth of the share. Then came the gangplow or multiplow, drawn by a tractor instead of horses. For such plows the share and moldboard was often impracticable so the disc-plow was invented, consisting of a circular disced metal share that turned the soil as it rotated. A variety of plows are manufactured for special uses, as for ditching, plowing on a side-hill, for paring sod, or for cultivating particular crops. See AGRICULTURE.

PLOWDEN, Edmund, English jurist: b. Plowden, Shropshire, 1518; d. 6 Feb. 1585. He was educated at Cambridge and Oxford, admitted to practice physic and surgery in 1552 and later studied law. He was returned to Parliament for Wallingford, Berkshire, in 1553, and in 1554 as member for both Reading, Berkshire, and Wootton-Bassett, Wiltshire; in 1554–55 he withdrew his company with 39 members who were dissatisfied with the proceedings of Parliament. Proceedings were brought against them for contempt. Plowden defended his own case, and the matter was dropped. He was returned to Parliament for Wootton-Bassett in 1555. After the accession of Elizabeth he received no further political recognition, his steadfast adherence to the Roman Catholic faith barring his path though he was admittedly the greatest lawyer of his day. No proceedings were taken against him, though he often appeared in court as counsel for those of his faith, Bishop Bonner being one of his clients. His works are highly valued as a clear and authoritative record of the law proceedings of his time. ‘Les Commentaires’ (1571) fully sustains his reputation as a great jurist, and he also wrote ‘Les Quæres del Monsieur Plowden’ (trans. 1662). Consult Granger, ‘Biographical History of England’ (1824); Wallace, ‘The Reporters’ (1882).

PLÜCKER, plük'ĕr, **Julius,** German mathematician and physicist: b. Elberfield, 16 July 1801; d. Bonn, 22 May 1868. He became a lecturer at Bonn in 1825, professor of mathematics there in 1829, and after holding a chair at Halle in 1834–36 was again at Bonn until his death. His contributions to mathematics were of much importance. He invented what is known as line (or linear) geometry, the theory of systems of rays, complexes and congruences, his uncompleted work on which was finished by Klein, his assistant, as ‘Neue Geometrie des Raumes’ (1868–69). In his ‘Theorie der algebräischen Curven’ (1839) he develops the “six equations,” known by his name, concerning the singularities of algebraic curves. From 1847 he devoted much attention to physics. He made study of the magnetic properties of gases and liquids, spectroscopy and electrical phenomena of light in rarified air. He originated the Geissler tubes and discovered the fluorescence of cathode-rays. His ‘Analytisch-geometrische Entwickelungen’ (1828–31) contains accounts of his labor in this field. Consult Dronke, ‘Julius Plücker’ (1871); Clebsch, ‘Zum Gedächtniss an J. Plücker’ (1872).

PLUM, the popular name for several species of the genus *Prunus*, extensively cultivated in mild climates for their fruits. They are widely distributed in the North Temperate zone, especially in America and eastern Asia. They have alternate, simple, leaves; white flowers mostly in cymes and generally appearing with the leaves; and drupaceous, one-seeded, bloom-covered fruits. They are closely related to apricots, cherries and peaches.

The most important species is the European plum (*Prunus domestica*), a native of the Caucasus region, and thought to have been derived from the blackthorn (*P. spinosa*). It has given rise to four distinct groups: *Prunes,* firm, thick-fleshed, sweet varieties of various colors (blues are best known), adapted for drying without the removal of the stone (see PRUNE); *Damsons,* little, firm-fleshed plums of diverse colors and usually clustered, frequent in fence corners; *Greengages,* small green, globular plums generally of high flavor; *Large,* yellow, blue, red and purple varieties. The domestics are the leading plums from New England southward to Pennsylvania, westward to Lake Michigan, and upon the Pacific Coast. Some of the hardier Russian varieties are being tried in the colder regions of the West and North.

Next in importance are the Japanese varieties of *Prunus triflora,* first introduced into America in 1870. This species is presumably a native of China. The fruits are generally rounder than those of the *domestica* varieties, and are more noted for their light reds and yellows. Their chief merits are: added variety to the list, especially of early maturing kinds, firm-fleshed fruits which ship well and vigorous, productive trees freer from the attacks of curculio and black knot (see below) than the *domesticas.* They succeed farther south than the *domesticas,* and in many instances farther north.

Several American species have also rapidly become popular in the United States and Canada. *Prunus americana* and *P. angustifolia* are the leading species, the former especially in the North and West, but also extending to the Gulf States; the latter popular from Pennsylvania southward. These are of still more recent introduction into cultivation than the Japanese varieties, and are valuable acquisitions where the two preceding groups fail. The wild goose plum is *P. hortulana.*

The following species are also cultivated: Myrobalan or cherry plum (*P. cerasifera*), presumably a Caucasian species, used largely by nurserymen for budding plums upon; apricot or Simon plum (*P. simonii*), an introduction from China popular in California since 1880, but little grown in the East; beach plum (*P. maritima*), common upon the coast from Nova Scotia to Virginia, but little cultivated except as an ornamental shrub; Pacific Coast plum (*P. subcordata*), indigenous in Oregon and California, and somewhat cultivated; and the sand plum (*P. angustifolia watsoni*), a shrubby species common in Kansas and Nebraska, but little cultivated.

Plums are propagated from seed only when new varieties are desired; varieties true to name are all propagated by budding or, to a very limited extent, by grafting. The process is the same as for the peach (q.v.). If *domestica* varieties are to be grown upon light soil they are generally whip-grafted on peach stocks, the peach being adapted to such soils. Similarly peaches to be grown upon heavy soil are often grafted upon plum stocks.

The various groups succeed upon a wide range of soil; the *domesticas* are generally well adapted to heavy soils; the Japanese to medium and even light; and the American kinds often to very light. There are, however, varieties in each group adapted to other soils than suit the majority. The land is deeply plowed and thoroughly harrowed before planting. The trees are set about 20 feet apart in squares or hexagons (see PEACH), or in rectangles from 8 to 12 feet asunder in rows 18 to 20 feet apart. In the last case cultivation is given only one way when the trees commence to touch. Usually less than half a dozen main limbs, preferably close to the ground, are allowed as the framework of the tree and after the first year or two little pruning beyond the removal of interfering, injured or dead branches is given. The trees are usually planted when two years old from the bud, extra vigorous growers sometimes when one year old. Varieties of the Japanese and American groups should not be planted in blocks of only one kind, since they are often self-sterile and fail to set fruit; two or more kinds should be alternated in the orchard. (See PEAR). Cultivation is practically the same as for apples and pears. In the Western States, however, a mulch of straw, marsh hay, etc., is often substituted for cultivation. The fertilizers usually employed are rich in potash and phosphoric acid. Cover crops of legumes should supply sufficient nitrogen, or a biennial dressing of stable manure may be used as a supplement. Occasional dressings of lime are often beneficial. Few fruits respond better to liberal feeding than the plum. The conservation of plant food which follows thinning the fruit, to stand at least two inches apart, is also of great benefit to both tree, annual productivity, size of fruit, and in the prevention of fruit rot. (See PEACH). When fully grown and colored but before becoming soft the fruits are gathered and generally marketed, in the East, in eight-pound Climax grape baskets. The plums shipped to eastern markets from California (mostly of the prune and Japanese types) are packed in boxes and sent by refrigerator express freight.

Some of the principal diseases of the plum are also common to the cherry or the peach, or both. Plum-pockets (*Exoascus pruni*) is a specific plum malady. Shortly after the blossoms fall the little plums swell rapidly to an inch long or more and become bladdery. As the disease progresses the light green color changes to deep brown or black, the walls thicken, the stone fails to develop and the fruit falls. Affected foliage and green twigs also become distorted. Spraying before the buds open and again after the flowers fall is recommended as a check. (See FUNGICIDE). Black, or plum-knot (*Plowrightia morbosa*) is common to both plums and cherries. Swellings appear upon the twigs and branches, burst and reveal a golden brown or yellow interior with velvety appearance due to the rapidly forming summer spores. As the season advances the surfaces change to black with a more or less pimply appearance. In the spring a second crop of spores (winter spores) is liberated. Under favorable conditions spores from either crop may spread the affection through crevices in the bark, etc. The knots are perennial, gradually extending the infested area. Cutting and burning as soon as discovered; painting the wounds with kerosene or Bordeaux mixture, thorough spraying with standard Bordeaux mixture before the buds open and with diluted mixture afterward are all recommended and should all be practised. One alone is insufficient. Badly infested trees and trees of wild cherries, plums, etc., should be burned promptly. Leaf blight or shot-hole fungus is produced by two species of fungi, *Septoria cerasina* and *Cylindrosporium padi*. Small purplish spots upon the leaves gradually turn brown and drop out leaving shot-like holes. If badly infested the leaves turn yellow and fall, sometimes defoliating the trees. Spraying with diluted Bordeaux mixture at intervals of two weeks from the time the leaves expand until midsummer is considered a specific. This disease is often found on cherries. Systematic annual spraying will hold all these diseases in check.

Comparatively few insects feed upon the plum. Some caterpillars and other leaf-chewing insects sometimes appear in devastating numbers, but they can usually be controlled with Paris green (lime should be added to prevent injuring the foliage); plant lice are sometimes troublesome, but whale-oil soap, kerosene emulsion, etc., are effective. (See INSECTICIDE). But the most serious enemy is the plum curculio (*Conotrachelus nenuphar*), which in many sections has completely destroyed the crop. The adults, small gray-black snout beetles less than a quarter of an inch long, appear in spring and until the fruit has formed feed upon the foliage. Then the females chew little crescent-shaped cavities in the young plums, and lay their eggs in holes bored beside the crescent or in the crescent itself. The white, footless larvæ burrow to the region of the stone where they live for about three weeks. The fruits fail to develop and fall, and the larvæ burrow into the ground where they pupate for about four weeks, emerging as adults which hibernate. They have only one brood. Before the trees blossom arsenites may be used; but jarring the adults into sheets in the early morning while they are torpid and dropping them into kerosene is most practised. Special machines like inverted umbrellas on wheels are in use in large plum orchards. The plum gouger (*Coccotorus scutellaris*) is a troublesome pest in the Mississippi River basin. Its habits are much like those of the curculio. It does not, however, make a crescent-like mark, and its larvæ feed in the stone instead of around it.

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PLUM, Date. See PERSIMMON.

PLUM BLOSSOM, Order of the. See ORDERS, ROYAL.

PLUM CURCULIO. See PLUM.

PLUMAGE. Feathers are pre-eminently the distinguishing characteristic of birds: all birds have them, while no other animal possesses them. As elsewhere described (see ORNITHOLOGY) feathers fill two important functions, the retention of animal heat in the body and the support of the bird in flight; and since they cover practically the whole bird, all the striking features of color and ornament so highly developed in this group, pertain to the feathers.

The typical or pennaceous feather consists of a hollow nearly transparent, cylindrical portion (calamus), which merges above into an apaque, usually squared shaft (rhachis). The calamus, or quill, is composed of a series of oblong cells nesting into one another and containing the «pulp» from which the growing feather is built up. When the feather is complete these cells are empty. The shaft bears on either side the webs or vanes, soft flexible surfaces which upon slight tension split up into their component parts — rami or barbs. These are slender lamellæ which branch off from the rhachis and in turn give rise to branches — radii or barbules. The anterior barbules of one barb overlie the posterior barbules of the next barb and the numerous cilia (barbicels) which they bear, many of which are hook-shaped at the tip, interlock with the thickened upper edge of the posterior barbules, binding the barbs together and forming the substantial web which is so essential to flight. In the inner web of a crane's feather 15 inches in length have been counted 650 rami each bearing about 600 pairs of radii, or nearly 800,000 radii for the inner web alone and far above 1,000,000 for the entire feather. At the point where the rhachis emerges from the calamus is a pit known as the umbilicus and here is frequently found a sort of secondary feather known as the hyporhachis or aftershaft; it is usually much smaller than the main shaft and more downy in character, but sometimes, as in the emu, is of the same dimensions and appearance.

Feathers are entirely products of the skin, being similar to the scales of reptiles rather than to the fur of animals so clothed. They do not grow continuously, but are periodically shed and replaced by other feathers. The first feathers appear as small papillæ on the skin of the embryo. Each papilla is produced by a group of cells known as the Malpighian cells, which increase and divide, part of them growing down and forming the lining of the feather-follicle, the others forming the feather itself and surrounding the central mass or pulp, which is well supplied with blood-vessels and furnishes the requisite nourishment to the growing feather. The Malpighian cells which produce the feather form three layers — a thin exterior one, the sheath which covers the young feather in what is familiarly called the «pin feather» stage and later scales off as the feather expands; a middle layer, which forms the feather itself; and a very thin innermost layer, which covers the pulp and which persists inside of the calamus as a series of pithy caps left by the retreating pulp. This pulp is withdrawn to the base of the follicle when the feather is completely grown and becomes active again when the feather is shed, or at the time of the periodical molting (q.v.).

Feathers are classified into (1) contour feathers — those which are outermost and give form to the bird; (2) down feathers,— the dense undercoating; (3) filo-plumes; and (4) powder-down feathers.

The first are usually pennaceous in structure, but in the various ornamental plumes, barbicels and even barbules may be wanting or reduced in number, producing a fluffy feather. The down feathers have no barbicels and usually no rhachis, but consist of long fluffy barbs, all of which grow out from the tip of a very short calamus. Filo-plumes are exampled by the long "hairs" found upon the body of the domestic fowl after the feathers have been plucked and commonly removed by singeing. They show under the microscope a degenerate feather structure of barbs and barbules. In the case of some birds, however, they become very long, reaching out beyond the contour feathers and influencing the coloration and texture. Powder-downs are down feathers which are constantly disintegrating into a fine powder and are found in the plumage of various birds, notably parrots, tinamous, herons and the species of *Podargus*.

With regard to age, feathers are divisible into two groups: (1) neossoptiles, or feathers of the young birds at the time of hatching; and (2) teleoptiles, or feathers of later life. The neossoptiles are of two kinds: (1) the prepennæ which immediately precede the contour feathers; and (2) the preplumulæ which precede the down feathers. A further division is made of the pre-pennæ into "protoptiles" and "mesoptiles," but these are important only to the scientific ornithologist. The neossoptiles are always downy in structure and after a varying period they are superseded by the teleoptiles. In the penguins there are two distinct plumages of neossoptiles one succeeding the other; the second growth beginning before the first is shed. The short calamus of the neossoptile never becomes closed up and is split longitudinally as it is forced out by the teleoptile and for some time its slender downy barbs are borne on the tip of the new feather. When one generation of teleoptiles succeeds another the old feathers usually drop out, but in the emus and cassowaries they remain attached to the tips of the new feathers, just as do the neossoptiles. Neossoptiles are best developed in the birds which run about within a short time after hatching, such as the gallinaceous birds, ducks, sandpipers, etc. In these species the body is thickly and completely covered with down. In the hawks and owls the covering is nearly as thick, but in the latter the neossoptiles grow out for a considerable time after hatching, sometimes completely altering the appearance of the bird. In the snowy owl, for instance, the newly hatched young with the tips of the neossoptiles showing, is pure white, while older ones, in which these feathers are full grown, appear dull gray, owing to the difference in color of the terminal and basal portions of the feathers.

In passerine birds the neossoptiles are not very abundant, while in several groups—notably the woodpeckers where the young are reared in hollowed trees and the kingfishers which burrow in sand banks — the neossoptiles have been entirely suppressed, so that the first coat of feathers on these birds consists of teleoptiles and the young birds are naked until these appear. This is perhaps owing to the protection afforded by the nest to the young, which renders the early downy covering less necessary. In the mound-builders a still more remarkable condition prevails. Here the neossoptiles are developed but are shed before the bird is hatched and it actually leaves the shell clad in the teleoptiles.

Feathers are not distributed uniformly over the body of a bird as are the hairs of a cat or rabbit, but they are in well-defined groups or areas known as "pterylæ," with bare spaces, "apteria" between. In some kinds of birds the apteria are covered with down feathers. The pterylæ are of characteristic outlines in different families and are thus of value in determining relationships.

It is obvious that the early plumage condition of birds is to some degree dependent upon their nesting habits and this must be clearly borne in mind when it is considered in connection with classification. Thus many apparently striking characters will be seen at once to have been very recently acquired.

Following the nestling stage, birds acquire one coat of feathers after another, the frequency of the change depending upon the number of molts. The first teleoptile or "juvenal" plumage is generally quite different from that of the adult, is worn for only a few months after the bird leaves the nest, when it is superseded by the plumage of the first winter, in which the characters of the adult generally appear. This may be retained for a whole year, or it may give way to a nuptial plumage in the early spring, the latter being always the case in birds which are strikingly different in color in summer and winter. It is now demonstrated that feathers cannot change their pigment after they are once developed and consequently striking changes are due to molt. There are some partial exceptions to this, in the case of birds whose plumage undergoes marked wear or abrasion, such as the snow-bunting. In this species the feathers of the back are black at the base, those of the head white, but both are broadly tipped with brown, and as they lie in place brown is the prevailing tint. In early spring the tips become brittle and fall away, leaving the black-and-white basal portions in strong contrast. In the crossbill, as shown by Dr. Dwight, the barbs are red and the barbules gray and in spring the latter fall off, resulting in a material brightening of the plumage.

The relation of the juvenal plumage to that of the adult bird is a matter of much interest, owing to the fact that it usually shows some ancestral characters, and often gives us a clue to the relationship of the species; for example, the young of our robin is spotted like the ancestral thrushes, while the adult has departed widely from this type in its plain rufous breast and slaty back.

In a large number of species the plumages of the male and female differ materially; the latter is always the more primitive, and the male generally assumes a dress similar to it for the winter, returning to his brilliant livery on the approach of the nuptial season. Darwin's theory of sexual selection, which was formerly held to account for the brilliant plumage and wonderful ornamental feathers of male birds is in the light of modern investigations not satisfactory, but no acceptable theory has yet been presented. Protective coloration in plumages has received a good deal of attention from

Wallace and others, and doubtless the theory in some cases has been unduly elaborated. While protective coloration plays a part in the evolution of plumage it is quite as likely that, for instance, pale desert forms are as much the result of the direct effect of the sun as purely protective development. The protective plumages of the ptarmigan both in winter and summer, and the curious protective or «eclipse» dress acquired by certain ducks in summer when rendered temporarily flightless by their peculiar method of molting, deserve mention in this connection.

Molt varies in extent, may be complete or only partial. That which takes place after the breeding season is always complete; but the spring molt may be complete or reduced to a few feathers only, varying greatly. Molting takes place after a definite plan which differs with the species. In ducks, and certain other water birds, the quills are shed all at once. See PTERYLOGRAPHY. Consult Chapman, F. M., ‹Handbook of Birds of Eastern North America› (Rev. ed., 1912; pp. 84–96); Dwight, J., ‹Sequence of Plumages and Moults of the Passerine Birds of New York› (in Annals of the New York Academy of Science, Vol. XIII, pp. 73–360, New York 1900); Stone, W., ‹The Molting of Birds› (in *Proceedings* of the Philadelphia Academy of Natural Sciences, 1896; pp. 108–167); Strong, R. M., ‹The Development of Color in the Definitive Feather› (in Bulletin of the Museum of Comparative Zoology of Harvard College, Vol. XL, No. 3; Cambridge 1902).

PLUMB-LINE. See PLUMMET.

PLUMBAGO, a genus of herbs or subshrubs of the order *Plumbaginaceæ;* the leadworts. The species, of which about a dozen are known, are natives of warm climates, especially western Asia and the Mediterranean region. They have variously formed, usually alternate, entire leaves; and white, pink or blue tubular flowers, arranged in terminal spikes or racemes. The best-known species are *P. capensis* and *P. rosea,* which are popular as greenhouse and garden plants. They are easily propagated by cuttings, and will thrive in any good potting or garden soil. In cold temperate climates cuttings rooted in the early autumn, grown in the greenhouse during the winter, and transplanted to the garden in the spring, will blossom through the summer and autumn and may then be used as winter plants or kept in a cellar. In southern California and other mild climates the plants often climb 15 feet or more it not molested, but in greenhouses they are usually straggling shrubs.

PLUMBAGO, or **GRAPHITE,** also called black lead. See GRAPHITE.

PLUMBING AND STEAM FITTING. The word «plumbing,» derived from the Latin *plumbum* (lead), as originally used, meant to seal or repair with this metal, but the term as now used, in its broadest sense, means the pipes, connections, fixtures, etc., used for the purpose of supplying water, gas, hot water, steam or hot air from outside places to the interior of a building, or of carrying these throughout the building; and also for the purpose of drainage. All the ancient nations employed lead pipes to some extent; water was universally conveyed through them when the pressure was too great for earthenware pipes; and the Romans used them in their aqueducts in crossing ravines or valleys where the construction of bridgework was difficult or impossible.

The improvement in plumbing fixtures was remarkably slow, and has taken place within the last 78 years. The trade of plumbing was practically unknown prior to that time, but upon the completion of the Croton Aqueduct in 1842, more substantial and durable pipes and fittings became necessary, a condition which ultimately led to the establishment of manufactories of plumbers' supplies. At first these concerns were engaged almost exclusively in the manufacture of lead pipe, sheet lead or iron pipe, which were the principal articles used by the plumber, but to-day lead has been largely replaced by other metals, and we find that the plumber and the gas, steam and water fitter use lead, copper, brass and various styles of plated pipe, and that the use of vitrified clay or sewer pipe has been almost entirely abandoned, except for connecting the house and street sewerage systems. The grade of work done by the plumber has made a very material advance, the work being done largely by licensed plumbers, and in many cases under the direct supervision of expert inspectors employed by the city. In nearly all large cities plumbing is governed by rules and regulations, carried into effect by the department of the city government appointed for that purpose, and it is the duty of such departments to enforce the regulations which define the class of work to be done, the sizes of the various kinds of pipes to be used, the class of fixtures, etc. Such work usually comes under the supervision of the building, or the sewerage and water supply departments. The service pipe, which connects the system of supply pipes in a building with the main in the street, is generally laid by the water department.

For many years the entire plumbing system of the ordinary dwelling consisted of a sink with hot and cold water faucets over it, and connected with the water-back and boiler attachments of the range. This was followed by the installation of the bath-tub — an unsightly affair, consisting of a wooden box lined with lead. This was in time replaced by the cast-iron tub, then the copper-lined tub, both of which were superseded by the modern porcelain bath-tub, which is of cast-iron with a porcelain finish. The fixtures supplied by the plumbing trade are almost innumerable. Faucets, cocks and valves are provided for each place where water is drawn; laundry tubs, provided with hot and cold water pipes, are installed in the kitchen; marble, cast-iron or steel wash bowls are placed in the bathrooms or sleeping-rooms of a dwelling; and shower and foot-baths are provided when desired.

The main feature of the plumbing in a modern dwelling lies in the water-closet and the system of pipes which carry off fouled water. In this division of plumbing more care and ingenuity have to be exercised by the plumber than in any other line of the trade, for it is with this division more than any other that the question of general public health is concerned. Hence this branch of work is often called sanitary plumbing. Sewage is a constant menace to health and it is the carrying off of refuse upon which the manufacturers have turned their inventive facilities. Though water-closets have been in use as long as have bath-tubs no special attention was paid to their improvement in construction till 1775, when the first patent was taken out in England by a watchmaker, named Alexander Cummings. This was of the siphon-trap style, and in 1778 was followed by a closet with a valve which worked on a hinge at the bottom of the bowl, the invention of Joseph Bramah. In 1792 another patent was granted for a valve closet supplied with a tank, the hopper of which was flushed by pressure on the seat. From that time the inventions were manv and various, until at the present time we have valve closets, pan closets, plunger closets, hopper closets, cistern closets, siphon closets and latrines. The old-fashioned pan closet, used almost universally many years ago, was one of the most unsanitary of all the plumbing fixtures in use, and because of its filth and stench has been generally discarded. It consisted of a metal pan which worked on hinges, and when let down emptied the contents into the discharge pipes. Then came the valve and plunger closets, which were later superseded by the siphon closets. The valve closet takes its water from the main service pipe, whereas the cistern closet receives its supply of water in the tank from the main, and it is then discharged in the bowl by pulling a hanging chain attached to a lever, which raises the valve in the cistern.

Water-closets are now most generallv constructed of glazed earthenware, some are made of the finest bona china and others again are made of cast-iron with a china finish. The old-styled closed plumbing has given way to the most modern sanitary appliances, and open work is generally to be found even in the poorest dwellings, because of its cleanliness, healthfulness and ease of access to repair.

The next part of the general sanitary system to be considered is the arrangement of pipes and appliances which connect the basins, sinks and water-closets with the general sewer. Ventilation is one of the most important subjects which the sanitary plumber must understand. How to prevent gases arising from sewers — for where there are sewers there is sure to be sewer-gas — and how to prevent the air in a room from becoming foul, have been constant sources of trouble to the modern sanitary plumber, and that he has solved these problems has probably resulted in more benefit and insured the public against more harm from diseases attendant upon these evils than any other one thing. It is an indisputable fact that the wise and exact observance of these sanitary laws has been a potent factor in materially reducing the death rate in our larger cities.

In this system of pipes the most important object is to prevent the air within them from gaining access to the building. This is most generally done by means of a trap or depression in the pipe, or by making the internal pipes gas-tight. The inverted siphon, sealed by water lying in the bend, is probablv the best form of trap. Fresh air should have free access to the pipes, the air of the sewer should be shut off from that of the pipes within the house and fouled water should be immediately and completely removed from the vicinity of the building. The ventilation largely affects the methods of connecting the main drain with the soil-pipes. The most general and easiest method of ventilating the soil-pipes is to extend the drain pipe to a point above the roof, and through this the current of air, which comes in at the manholes in the street and passes along the street sewers, flows upward and out. The method is most effective where the street sewers are constructed on the «separate» system, but where the street sewers are built on the «combined» plan, it is preferable to have a trap on the house sewer in connection with the fresh air inlet, because of the fact that the foul-air currents are thus diverted from the interior pipes and a current of fresh air is forced upward through the soil and ventilating pipe.

Waste pipes should be of lead, though sometimes cast or wrought-iron is preferable because of the large diameter required and the soil; waste and ventilating pipes should be exposed as much as possible for purposes of inspection or repair. The main house drain and the soil pipe should be of heavy cast-iron with lead-calked joints, and all iron pipes and fittings should be coated with coal-pitch varnish, both inside and outside. If plumbing work be carried out on the ideas set forth, with proper traps, light, ventilation, simplicity, accessibility, good workmanship and a high grade of material throughout the public health will properly be insured against the ravages of disease so common before the improved appliances came into vogue.

Another distinct division of the plumbing trade is the carrying of steam in pipes throughout a building. Prior to 1840 and even as late as the Civil War, the growth of steam heating had not assumed any great proportions. English inventors had made many attempts at steam heating by means of small pipes connected with boilers, on the theorv that this would create a high temperature. But this soon gave way to the low pressure system because of the fact that there was little or no wear upon the apparatus, and the generation of the low pressure saved fuel. Joseph Nason, of New York, and J. J. Walworth, of Boston, were largelv instrumental in the earlier development of the industry. Boilers were first used, but these were quickly followed by radiators constructed of wrought-iron tubes, both vertical and horizontal. In 1865 the manufacturers began to make heating boilers and radiators from cast-iron, and the manufacture of steam and hot-water furnaces has become an industry of great importance. The development of the modern office building has in a large measure added to the success of this branch of the trade, for it is in these that this system of heating is carried to its greatest degree of perfection. The boilers used in these buildings are of wrought-iron or steel, because the running of elevators, electric lights and pumps, necessitates that a high pressure be maintained on the boiler.

The industry is now so complex, drawing its supplies from several lines of manufacture, and consisting mainly of contracting work, that accurate statistics of its extent cannot be compiled. Consult Starbuck. R. M., 'Modern Plumbing Illustrated' (1915); and Gerhard, 'Sanitary Engineering of Buildings' (1915). See Boiler; Bath; Drainage; Public Health; Sanitary Engineering; Sanitary Science; Valves; Waret: Its Relation to Disease, Etc.

PLUMBOJAROSITE, a lead ore consisting of a hydrous sulphate with iron, $PbFe_6(OH)_{12}(SO_4)_4$, occurring in mines in Colorado, Nevada, New Mexico and Utah.

PLUME-MOTH, or **FEATHERWING**, one of the small moths of the family *Pterophoridæ*, allied to the clothes-moths, which are readily distinguished from all others by the fact that their wings are deeply cleft at the edges, so as to resemble five (sometimes six) feathers on each side of the body. Some 70 species have been enumerated. The grapevine plume-moth (*Oxyptilus periscelidactylus*) as larvæ leaves silk-like strands on the leaves of the grapevine. The caterpillars develop to pupæ in the early summer. As moths they have slim bodies and 16 legs, and are of numerous colors. The *Ooneodidæ*, having six side feathers, are also classed as plume-moths.

PLUMED KNIGHT, The, a name applied to James G. Blaine (q.v.). It was first used in a speech made by Col. Robert G. Ingersoll, when nominating Mr. Blaine for the Presidency in 1876.

PLUMIER, plü-mē-ā, **Charles**, French botanist: b. Marseilles, France, 1646; d. Santa Maria, near Cadiz, Spain, 1704. He studied under Joseph de Tournefort, and in 1689 went to the West Indies, engaged in botanical researches under the government and on his return published 'Description des Plantes de l'Amérique' (1693). Subsequently in 1693 and 1695 he made voyages to America at the request of the king, and he was about to sail on a fourth voyage when he died. His 'Traité des Fougères de l'Amèriques' (1705) is still an authority; among his other works are many valuable manuscripts in the library of Paris and in the Jardin des Plantes, and 'Nova Plantarium Americanarum Genera' (1703). Consult Haller, 'Bibliotheca Botanica.'

PLUMMER, Alfred, English Biblical scholar: b. Heworth, Durham, 17 Feb. 1841. He received his education at Exeter College, Oxford; was Fellow of Trinity College in 1865–75; tutor and dean in 1867–74; and master of University College, Durham, from 1874 to 1902. He published translations of several of Dr. Döllinger's works (1870–75); commentaries on II Saint Peter and Saint Jude (1879); 'Saint John's Gospel and Epistles' (1880–86); 'The Pastoral Epistles' (1889); 'Epistles of Saint James and Saint Jude' (1890); 'Introduction to Joshua and Nehemiah' (1881); Handbook on the Church of the Early Fathers' (1887); 'Commentary on Saint Luke's Gospel' (1896); 'Second Corinthians' (1903; enlarged ed., 1914); 'Saint Matthew' (1909); 'Saint Mark' (1914); 'Lectures on English Church History, 1575–1649' (1904); 'Lectures on English Church History, 1509–1575' (1905); 'Lectures on English Church History, 1649–1702' (1906); 'The Church of England in the 18th Century' (1910); 'The Churches in Britain before A.D. 1000' (1911); 'The Humanity of Christ and Other Sermons' (1913); 'Continental Reformation in Germany, France and Switzerland' (1912).

PLUMMER, Mary Wright, American librarian: b. Richmond, Ind., 1856; d. 21 Sept. 1916. She was educated at Wellesley and at Columbia University, was librarian of the Pratt Institute Free Library, Brooklyn, in 1896–1904, also director of the Library School there from 1896 to 1911. After 1911 she was principal of the Library School of the New York Public Library. Miss Plummer was president of the American Library Association in 1915. Her publications include 'Hints to Small Libraries' (1894; 4th ed., 1911); 'Verses' (1896); Contemporary Spain' (1899); 'Roy and Ray in Mexico' (1907); 'Roy and Ray in Canada' (1908); 'Stories from the Chronicle of the Cid' (1910).

PLUMMET, or **PLUMB-LINE**, a leaden or other weight let down at the end of a cord to regulate any work in a line perpendicular to the horizon, or to sound the depth of anything. Masons, carpenters, etc., use a plumb-line fastened on a narrow board or plate of brass or iron to judge whether walls or other objects be perfectly perpendicular, or *plumb* as the artificers call it. Near a range of high mountains the plumb-line, as has been demonstrated by a number of experiments, is not perfectly true, but inclines toward the mountains; and officers in charge of the United States Coast and Geodetic Survey among the Hawaiian Islands have observed that the deviation of a plumb-line from the vertical is greater in the case of mountains in an island than in continental mountains, and greater in the neighborhood of extinct volcanoes than in that of active volcanoes. In given localities the plumb-line also varies according to the ebb and flow of the tide.

PLUMPTRE, plŭmp'tr, **Edward Hayes**, English theologian and scholar: b. London, 6 Aug. 1821; d. Tunbridge Wells, 1 Feb. 1891. He was educated at Oxford, and was successively chaplain at King's College, London (1847), professor of pastoral theology there (1853), and professor of exegesis there in 1864. He was also appointed prebendary of Saint Paul's, London (1863), rector of Pluckley, Kent (1869), and vicar of Bickley, Kent, in 1873. In 1869–74 he was one of the revisers of the Old Testament and was appointed dean of Wells in 1881, a position which he held until his death. Among his published works are 'Lazarus and Other Poems (1864); 'Master and Scholar,' verse (1866); 'Christ and Christendom' (1867); an excellent verse translation of Sophocles (1865), and a similar one of Æschylus (1868); 'Biblical Studies' (1870); 'The Law of Progress in Theology' (1876); 'Saint Paul in Asia' (1877); 'Movements in Religious Thought: Romanism, Protestantism, Agnosticism' (1879); 'Theology and Life' (1884); 'Things New and Old,' verse (1884); 'The Spirits in Prison' (1884); a verse translation of the Commedia and Canzoniere of Dante (1886–87); 'Wells Cathedral and its Deans' (1888); 'Life of Bishop Thomas Ken' (1888).

PLUNKET, William Conyngham, 1st Baron Plunkett, British statesman: b. Enniskillen, Ireland, 1 July 1764; d. Old Connaught, Wicklow, Ireland, 4 Jan. 1854. He was graduated from Dublin University in 1784, admitted to the bar in 1787 and in 1797 became king's counsel. In 1789–1800 he sat for Charlemont in the Irish Parliament and acquitted himself with much credit until the extinction of that body. He was appointed solicitor-general in 1803 and appeared for the prosecution at the trial of Robert Emmet; in 1805 he was appointed attorney-general for Ireland and in 1807 and 1812–22 sat in the British House of Commons, where as a Protestant he made a resolute fight for Catholic emancipation. In 1822 he was raised to the peerage, was attorney-general of Ireland 1822–27, chief justice in 1827–30 and Lord Chancellor from 1830–41, when he retired from public life. Consult Plunket, David, 'Life, Letters and Speeches of William Conyngham Plunket' (1867).

PLUNKETT, Horace Curzon, Sir, Irish statesman: b. in Ireland 1854. He graduated from Oxford, and came to America, in 1879. After 10 years in Montana, he returned to the old soil, and soon became active in politics. He adopted the interests of the farmers, and in 1894 founded the Irish Agricultural Organization. He had in 1892 gone into Parliament as a Unionist. He advocated discussion and harmony, and urged a "Recess Committee" to work on these lines. He was made chairman, and had on his committee Earl Mayo, John Redmond, The O'Conor Don and Thomas Sinclair. Thereupon Plunkett worked up a long report in the systems of agricultural aid extended in other countries, and his committee backed it. The result was the act of 1899 establishing a Department of Agriculture in Ireland, with Plunkett as vice-president. He remained in the office even under the Liberal opposition until 1907 when he was pushed aside by politics. In 1903 he was knighted; in 1911 he was returned to office, and 1914 was active in the effort to pacify Ulster. Later he advocated Home Rule. He published 'Ireland in the New Century' (1904); 'Department of Agricultural Instruction and Technical' (Ireland 1907); 'A Better Way: an appeal to Ulster' (1914).

PLURALISM. This term is used in current philosophical discussion to denote the view that regards the world as composed of a number or plurality of beings of distinct and independent nature. It is thus opposed to Monism (q.v.), which asserts that there is only one ultimate form of reality (as for example, with Spinoza, who regards all finite things as modes or manifestations of one substance, or with the idealism of the present day which interprets all forms of existence as parts of an Absolute Experience). In some sense both Monism and Pluralism must be true; that is, in some sense the world is one, a single universe, and in some sense it is composed of many various parts. The ultimate problem of philosophy is to define the sense in which each of these propositions is true, to reconcile the point of view of the one with that of the many.

The practical motive in the opposition between Monism and Pluralism lies chiefly in the necessary implications of these theories regarding the place and importance of the human individual in the world. Pluralism is a protest against a Monism that would merge the many individuals in a one all-embracing, absolute system, and thus leave no place for their independent life and power of free initiative. Against the "block world" of Monism, the Pluralists insist on the separateness and uniqueness of the personal life of the human individual, which cannot be reduced to a mere part or element in a larger whole. On the other hand, the Monists point out that through over-emphasizing the independence and separateness of individuals, the Pluralists are unable to reach any intelligible conception of a system or universe of things, or to discover any common standard of truth or of conduct. J. E. Creighton,
Professor of Logic and Metaphysics, Cornell University.

PLURALISM, *in canon law,* the holding by the same person of more than one ecclesiastical office of dignity or emolument. From early times it has been legislated against by various councils, but it is now very rare in the Catholic Church. In the Anglican Commission it is regulated by the Pluralities Act of 1838, as amended in 1850. Consult the 'Catholic Encyclopedia' (15 vols., New York 1905–15).

PLURALITY, (1) in ecclesiastical law, the holding of more than one office by the same person; also, one of the offices so held. (2) The greatest of three or more numbers; also, the excess of the highest number over the next highest. In this sense, the word is commonly used in elections in the United States when one candidate has received more votes than any one of two or more opponents. Thus, if one candidate receives 40,000 votes, a second 35,000 votes and a third 25,000 votes out of a total of 100,000 votes cast, the first is declared elected by a plurality of 5,000 votes.

PLUSH, a textile fabric, usually of wool, cotton or silk, having a cut pile on one side, distinguished from velvet in that the pile is longer. A well-made plush is costly but beautiful and may be produced to closely imitate seal-skin. It has become common to weave silk plush on a cotton foundation.

PLUTARCH, ploo'tärk (Gr. Πλούταρχος), Greek writer: b. Chæronea, Bœotia, about 46 A.D.; d. there, about 125. He studied philosophy under Ammonius, a peripatetic philosopher of Attica, in 60 A.D., which is the only indication of his age. He several times visited Rome, where during the reign of Vespasian he remained for some little time, giving lectures in philosophy and collecting materials for his 'Lives.' He spent his later years at Chæronea, where he had a priesthood and was also an archon and building-inspector. To many friends he was guide, philosopher and mentor, expounding especially the tenets of the Greek moralists then very popular among men of culture. A school or group gathered about him to which he lectured on Greek and Roman institutions. He was a great admirer of the Spartans, but appears not to have been fully conversant with Roman institutions. His 'Parallel Lives of Illustrious Greeks and Romans' is the work to which he owes his fame. The lives are written in pairs, one Greek and one Roman, followed by a comparison of the two, which in some instances is wanting. A few of the 'Lives' themselves are lost. In these 'Lives' Plutarch is said to have quoted 250 authors, the works of many of whom are lost. The work is chiefly intended for the illustration of character, and as he makes use of incidents for this purpose without regard to their relative value, is only partially serviceable for historical purposes. In the arrangement of his incidents he does not always follow a chronological order. Their excellence consists mainly in their fidelity in biographical portraiture. They traverse all of the classical antiquity, are the prime authority, and the only one, for numberless factors, and contribute more, perhaps, along certain lines to the knowledge of the ancient world than does any other one work. A knowledge of them was long considered indispensable to culture. A Latin collection, consisting of translations made by different persons of the separate lives, was printed in Rome in two volumes folio in 1470. The first edition of the text was printed in Florence in 1517. An edition by Bryan, with Latin translation (completed after his death by Du Soul), was published in 1729. There are editions by Coraes (1809–15), Sintenis (1839–46), and Dübner (1846–47). Among translations there is the fine French translation by Amyot (1559), and there is of this the worthy English version by Sir Thomas North (1579), characterized as “Shakespeare's storehouse of learned history,” since to it the great dramatist was indebted for his outlook on classical history and some of his finest characters and plots, as also one by Evelyn, Garth, Creech and others, with a life by Dryden (1638–86); and one by John and William Langhorne (1770, with several subsequent improved editions). The translation called Dryden's was corrected and revised by A. H. Clough, and published in 1859. George Long has translated and annotated some of the ‘Lives.’ Plutarch's other works, about 60 in number, are generally classed as ‘Moralia,’ though some of them are narrative. The style of some is difficult while the genuineness of others is open to question. They include ‘On the Education of Children,’ in which some sterling maxims are propounded for the guidance of parents, who, according to Plutarch, should be of equal rank; ‘How a Young Man Ought to Hear Poetry,’ containing very many quotations from Homer and the tragedians; ‘On the Right Way of Hearing,’ in which the value of silence is emphasized, caution not to give too great weight to a speaker's style and diction, and a generous appreciation advocated; ‘How a Flatterer may be Distinguished from a Friend,’ evidently the world of Plutarch's day suffered more from flatterers than we do today; the work abounds in quotations; ‘How One May be Conscious of Progress in Goodness,’ in which are given various criteria by which our moral progress may be measured; ‘How to Get Benefit out of Enemies’ advises turning our enemies to some good purpose for ourselves either by inducing in us an honest life so that they may be made jealous of us, or by their criticisms pointing out the way we must travel toward perfection, etc.; ‘On Having Many Friends’; ‘On Chance’; ‘On Virtue and Vice,’ all three containing numerous citations, otherwise unknown to us; ‘Precepts About Health’ is strewn with many platitudes enunciated in technical and difficult idiom; ‘Advice to the Married,’ containing short precepts and anecdotes and a few citations; ‘The Banquet of the Seven Wise Men,’ a treatise in narrative form of what happened at a public gathering near Cornith; ‘On Superstition,’ containing numerous quotations and many excellent maxims applicable even in our day; it is one of the most interesting of the ‘Moralia’; ‘On Isis and Osiris,’ a treatise on Egyptian symbolism of great interest to Egyptologists; ‘On the Cessation of Oracles,’ a discussion of the decline in popularity of the old Greek seats of worship and prophecy; ‘On the Face of the Moon's Disk’; ‘On Fate’; ‘On the Genius of Socrates’; ‘On Exile’; ‘Consolation to His Wife,’ a feeling exhortation to a grief-stricken mother; ‘Short Sayings’; ‘Parallels,’ etc. Philemon Holland executed an English translation of the ‘Morals’ (1603), and there is also a translation revised by W. W. Goodwin (1874–78). An edition of all the works of Plutarch, by J. C. Hutten, appeared at Tübingen (1791–1805). There is also a Paris edition with Latin translation (1862–77). The latest English translation is by Clough, A. H. (5 vols., New York 1909). The best text of the ‘Moralia’ is that of Bernardakis (1888–97). The name Plutarch is sometimes given to a collection of lives of distinguished men. Consult also Volkmann, ‘Leben, Schriften, und Philosophie des Plutarch’ (Berlin 1873); Oakesmith, John, ‘The Religion of Plutarch’ (New York 1903); Gréard, ‘De la morale de Plutarque’ (Paris 1866); Trench, R. C., ‘A Popular Introduction to Plutarch’ (London 1873); Wright, W. C., ‘A Short History of Great Literature’ (New York 1907). See PLUTARCH'S LIVES, NORTH'S TRANSLATION OF.

PLUTARCH'S LIVES, North's Translation of. Sir Thomas North was a soldier and public official rather than a man of letters, but he shared with other Elizabethans that striking versatility which enabled so many of them to attain distinction in more than one field of activity. His literary works were all translations, the most important being his Plutarch. Various other translations of the ‘Lives of the Ancient Grecians and Romans’ have appeared since North's, but none has supplanted his in interest for the general reader. The scholar will not be satisfied by North's version, for North translated not from the Greek original, but from the French version of Bishop Amyot. His purpose was not to produce a literally faithful translation, but one which would put the spirit of Plutarch into an Elizabethan body. His ulterior aim was to provide a series of “noble men's lives” which should serve as models of conduct to his own contemporaries, for he thought wisdom might be acquired better in this way than by reading about it “in philosophers' writings.” His knowledge of men and affairs made him peculiarly appreciative of the elements of character, and none of the flavor of Plutarch's Grecians and Romans has evaporated in their transition through French into English. Amyot's French version, though fairly close to the original, was written in a somewhat formal, Ciceronian style, but North chose to write in a more familiar and realistically contemporary manner. His style is, therefore, more pointed, more concrete and picturesque than either the Greek of Plutarch or the French of Amyot. By means of a word or synonym added here and there, by phrases slightly altered, he increased greatly the vividness of the narrative. Where Amyot was dignified, North frequently substituted homely and familiar images and phrasing. Thus where Amyot translates "Ne s'etoit jamais party de sa maison," North gives a more concrete turn to the passage in his "never went from the smoke of his chimney." An infinitude of slight variations of this kind makes of North's Plutarch a much more lively, more intimate and entertaining work than the French version upon which it was based. In the end they constitute rather an interpretation than a translation of Plutarch. The supreme test of North's ability to seize upon and express vividly the essentials of a character is to be found in the fact that Shakespeare in his Roman plays frequently took over bodily North's phrasing, often with only such slight modifications in word order as were necessary to change North's prose into blank verse.

George Philip Krapp.

PLUTEUS. See Larva.

PLUTO, ploo'tō, in Greek mythology, the giver of wealth, or Hades, the god of the lower world. The former name gradually superseded the latter, which was more commonly used by the poets. He was the third son of Cronus (Saturn) and Rhea, a brother of Zeus (Jupiter) and Poseidon (Neptune), and to him, on the partition of the world, fell the kingdom of the shades. But there was another view of his character. He became a benevolent being, who held in his hand the keys of the earth, and blessed the year with fruits; for from the depth of the earth proceed the grains and the plenty which attends them. He fought with his brothers against the Titans, and received from the Cyclops, whom he had released, the helmet that makes its wearer invisible, which he lent to Hermes in the war of the giants, and to Perseus in his expedition against the Gorgons, and which afterward came into the possession of Meriones. He judges every open and secret deed, and to him are subordinate the three judges Æacus, Minos and Rhadamanthus. The cypress, the box, the narcissus and the plant adiantum (maiden-hair) were sacred to him; oxen and goats were sacrificed to him in the shades of night, and his priests were crowned with cypress. He is represented in gloomy majesty, his forehead shaded by his hair, and with a thick beard. His head is sometimes covered with a veil. He frequently also wears his helmet, or a crown of ebony, or a wreath of adiantum or narcissus. In his hand he holds a two-forked sceptre, a staff or a key; by his side is Cerberus. He is either seated on a throne of ebony or in a chariot. Since he did not heed sacrifice or prayer, he was worshipped only on rare occasions. The Romans identified him partly with Orcus, partly with Dis. Consult Gayley, C. M., 'Classic Myths in English Literature and Art' (Boston 1911). See Persephone.

PLUTONIC ROCKS, those igneous rocks which were formed at great depths beneath the surface of the earth, under pressure, and have later been forced toward the surface. They have usually a distinctly crystalline structure, due to their having cooled slowly, and are contrasted with volcanic rocks which, while also of igneous origin, have been poured out at or near the surface of the earth and have solidified there. The granites are the chief of the plutonic rocks.

PLUTUS, ploo'tŭs, Greek god of wealth, son of Iasion and Demeter. He was blinded by Zeus in order that he might not confer riches on the good alone. In Greek statuary he is represented as a boy with a cornucopia symbolically indicating that through agriculture comes wealth. His residence is beneath the ground and this has sometimes confused his identity with that of Pluto. He comes to mortals weak and lame, but departs from them with winged feet.

PLUVIOSE, plü-vē-ōz, in French chronology, the name adopted, in October 1793, by the French Convention for the fifth month of the republican year. It commenced on 20 January and was the second winter month.

PLYMLEY, plĭm'lĭ, Peter, pseudonym of Sydney Smith (q.v.). In 1807–08 he published 'Letters on the Subject of the Catholics to my Brother Abraham by Peter Plymley,' which enjoyed a wide circulation and greatly furthered the cause of Catholic emancipation.

PLYMOUTH, plĭm'ŭth, Conn., town in Litchfield County, on the New York, New Haven and Hartford Railroad, 10 miles north of Waterbury. Saw mills and granite quarrying are its chief industries. Pop. 5,020.

PLYMOUTH, England, an important seaport and commercial town of Devonshire, on Plymouth Sound, between the estuaries of the Plym and Tamar, 36 miles southwest of Exeter. Devonport on the west, Stonehouse in the middle, and Plymouth proper on the east, constitute the aggregate known as "The Three Towns." The area of Plymouth proper is four square miles; of the three towns eight square miles. Devonport has on the west the Hamoaze or lower part of the Tamar estuary, and is divided from Stonehouse and Plymouth proper by an inlet crossed by several bridges. (See Stonehouse and Devonport). Plymouth extends from Stonehouse on the west to the Plym or Catwater on the east. The site is uneven, consisting of a central hollow and two considerable eminences, one on the north, and the other, called the Hoe, on the south, laid out as a promenade and recreation ground, from which a magnificent view is obtained. On the Hoe has been re-erected (Smeaton's) old Eddystone lighthouse, and there are also here a statue of Sir Francis Drake, and a memorial of the Armada. At the east end of the Hoe, on a bold headland, stands the citadel erected in the time of Charles II. The older parts of the town consist of narrow and irregular streets, devoid of architectural beauty, and often steep and winding. But in the newer parts and suburbs many handsome terraces and villas have been erected. The public buildings include the guildhall, a handsome Gothic building; the Royal Hotel and theatre, in the Grecian style; the post office; the custom-house, the exchange, the Athenæum, the Mechanics' Institute, the Plymouth and Cottonian public library, containing 10,000 volumes, and a collection of original drawings, prints, paintings and artistic articles, the grammar and other endowed schools, the Public Dispensary, Female Penitentiary, Eye Infirmary, South Devon and East Cornwall Hospital, etc. The laboratory and headquarters of the Marine Biological Association are located here. Among ecclesiastical buildings are the two parish churches, Saint Andrew's Church, a fine Gothic building of the 15th century containing some fine monuments, and Charles' Church, of the 17th century, with an elegant spire; Sherwell Congregational Chapel and the Roman Catholic Cathedral.

The manufactures include soap, sail-cloth, brushes, Roman cement, earthenware. rope and twine, etc., and there are also ship-building yards, foundries, two sugar refineries, breweries, starch-works and flax, saw and flour mills, together with limestone quarries. The fisheries, chiefly of whiting, hake and mackerel, are very productive. The trade also, both coasting and foreign, is very important. Steamers ply regularly to North America, the Cape, Australia, New Zealand, the West Indies, etc. The parts of the port chiefly appropriated for mercantile shipping are Sutton Pool and Mill Bay, particularly the latter, where there are extensive wet-docks, and the largest vessels lie in safety along its fine pier and pontoon at low water.

Plymouth owes its celebrity chiefly to its importance as a great royal naval station, for which the spaciousness of its sound renders it admirably suited. It has been the scene of immense activities during the World War. Originally, however, the sound, about three miles wide at its mouth, being open to the southwest winds, left vessels at anchor exposed to the greatest danger. With the view of protecting the anchorage from the heavy swell of the sea, the stupendous Plymouth breakwater was undertaken, and finally completed at an expense of about $10,000,000. On the west end of the breakwater a lighthouse, 68 feet above the platform, and visible at the distance of eight miles, except in foggy weather, has been erected, but the entrance into the sound is guided by the still more celebrated Eddystone lighthouse, which stands on a large cluster of rocks in the channel opposite to it. To defend the port an iron-cased fort was built near the breakwater, and Saint Nicholas, or Drake's Island, within the breakwater, has been furnished with strong fortifications, mounted with heavy guns. Various other forts and batteries also defend the place. The chief naval establishments are in Devonport and Stonehouse, the former having the royal dock-yard for building and repairing ships, the steam-yard for machinery and boilers, etc.; while Stonehouse has the victualing yard, naval hospital, marine barracks, etc. The Hamoaze is a favorite anchorage for men-of-war.

Plymouth, originally a fishing village, bore in very early times the name of Tamarworth, which, after the Conquest, was changed to that of Sutton, or South Town. It had become a considerable town under its present name in 1438, when a charter, confirming its old and granting many new privileges, was conferred upon it by Henry VI. From Elizabeth it obtained a new charter through the solicitation of Sir Francis Drake, and on the threatened invasion of the Armada the British fleet had its rendezvous here. Bonaparte arrived here in the *Bellerophon* in 1815. The total tonnage arrived and cleared in 1915 was 4,078.000. Pop. (1914) 113,134. Consult the histories of the town by Worth (1871) and Williams (1898).

PLYMOUTH, Ind., city and county-seat of Marshall County, on the Lake Erie and Western, the Vandalia and the Pennsylvania railroads, 82 miles southeast of Chicago. It is the seat of the Julia E. Work Training School, Saint Michael's Academy, Plymouth Sanitarium, and has a public library, basket works, barrel factory, notion factories, grinder mills, etc. It is also a thriving commercial centre; was settled in 1835 and incorporated in 1852. The water-supply system is the property of the municipality. Pop. 3,838.

PLYMOUTH, Mass., town, county-seat of Plymouth County, on Plymouth Harbor, a part of Massachusetts Bay, and on the New York, New Haven and Hartford Railroad, 38 miles southeast of Boston. It was here that the Pilgrims landed from the *Mayflower,* 21 Dec. 1620, and established the first *permanent English* colony in America. Plymouth Rock on which they first landed is carefully preserved, and is now covered by a granite canopy. Other places of interest in the town are Pilgrim Hall, where books, pictures and other valuable relics of the Pilgrims and Colonial times are kept, Leyden street, on which the early settlers built, and Cole's Hill and Burial Hill, where many of the first settlers are buried. Plymouth also has the national monument to the Pilgrims, dedicated in August 1889. Its central figure is a granite statue of Faith, with the four figures of Morality, Law, Education and Freedom at the base; the height of the monument is 81 feet. The town has a variety of manufactures; they include cordage (the largest manufactory in the world of this kind, employing about 2,000 persons and running night and day), woolen goods, tacks, insulated wire, nails and electrical supplies. The harbor is nearly land-locked, and contains about 2,000 acres of flats, on which are extensive «clam gardens,» the scientific cultivation of these shellfish forming an important industry. Deep channels admit large ships and barges to the wharves. Foreign steamships bring large amounts of fibre directly to the Cordage company from Yucatan, and the entries at the Plymouth custom-house show that, as a port of foreign import, Plymouth ranks in Massachusetts directly next to Boston.

Plymouth is an electrical centre, distributing to the surrounding towns light, power for street railways, and illuminating the Cape Cod Ship Canal each night on both sides of its entire land length of eight miles.

The manufacturing product of the town aggregates about $14,000,000 annually. On account of its beautiful situation and historic interest Plymouth is also a popular summer and tourist resort, its annual visitation exceeding 100,000 and including many summer dwellers. It has a fine forest park of 200 acres. The waterworks are owned and operated by the town. Pop. 14,000. Consult Banvard, 'Plymouth and the Pilgrims'; Davis, W. T., 'History of the Town of Plymouth' (Philadelphia 1885); Bradford, 'History of Plymouth Plantation' (1898); Baylies, Francis, 'An Historical Memoir of the Colony of New Plymouth' (2 vols., Boston 1866); Bliss, W. R., 'Old Colony Town and Other Sketches' (Boston 1893); Davis, W. T., 'Ancient Landmarks of Plymouth' (2d ed., ib. 1899); Goodwin, T. A., 'The Pilgrim Republic' (ib. 1888); 'Records of the Town of Plymouth' (Plymouth 1889–

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92); Bradford, William, ‹History of Plymouth Settlement, 1620–50,› edited by Paget (New York 1909). See MASSACHUSETTS.

PLYMOUTH, N. H., town, one of the county-seats of Grafton County, on the Pemigewasset and Baker rivers, and on the Boston and Maine railroad, 40 miles north of Concord. It is in a region noted for fine scenery, and is a popular summer resort. It has a number of manufactures, including gloves, shoes, boxes, lumber, etc.; also a bank and a newspaper. It contains the county courthouse where Daniel Webster pleaded his first case, and the house in which Nathaniel Hawthorne died. The town has a public high school and a public library and waterworks. It is also the seat of the State Normal School, and of the Holderness School for Boys (Episcopal). Pop. (1910) 2,250. Consult Stearns, E. S., ‹History of Plymouth, N. H.› (1906).

PLYMOUTH, N. C., town, county-seat of Washington County, on the Roanoke River, a few miles from where it enters Albemarle Sound, and on the Atlantic Coast Line Railroad, 105 miles east of Raleigh, and 75 miles north of Newbern. It is the trade centre of an agricultural region and ships lumber, cotton, rice and vegetables. There is a veneer factory. There is steamboat connection with Baltimore and Norfolk. It is the seat of a State Normal School. The population is about 2,165.

PLYMOUTH, Pa., borough, Luzerne County, on the Susquehanna River, and on the Delaware, Lackawanna and Western Railroad, four miles west of Wilkesbarre. It was first settled in 1768, and during the trouble between Pennsylvania and Connecticut in regard to boundaries (1799) was claimed by both States In the last decade of the 19th century, its growth was particularly rapid. It is in the great anthracite coal region of Pennsylvania, and its chief industries are the mining and exporting of coal; it also manufactures drills and other mining machinery, and hosiery. It contains a borough and a township high school and a parish school. Pop. 19,000.

PLYMOUTH, Wis., city in Sheboygan County, on the Chicago and Northwestern, and the Chicago, Milwaukee and Saint Paul railroads, 15 miles west of Sheboygan. The county fair grounds are located here and there are also a public library, park, flour mill, furniture factory, cheese manufactories, feed-cutter works and gasoline engine works. The electric-lighting plant and water-supply system are the property of the municipality. Pop. 3,094.

PLYMOUTH (N. C.), **Engagements at.** When General Burnside had occupied Roanoke Island and Newbern in February and March 1862, the Union gunboats became active in patroling the waters of North Carolina and seizing the coast and river towns. Plymouth was occupied in June by Lieut. C. W. Flusser, United States Navy, and was held by him until relieved 15 June by a company of the 9th New York infantry; 10 Dec. 1862 the town was held by about 300 men under command of Captain Ewer, 3d Massachusetts infantry. Early that morning Ewer was attacked by Lieut.-Col. John C. Lamb, with the 17th North Carolina, a few cavalry and some artillery, in all about 600 men. Ewer's pickets were quickly driven in, and his men took refuge in the custom-house. Lamb's artillery opened fire; the town was fired in several places; and the gunboat *Southfield*, lying abreast of the place, received a shot in her boiler, which disabled her, and she drifted down the stream. The gunboat *Commodore Perry* coming up, Lamb retired after being in the town about an hour and reducing most of it to ashes. From 10 to 13 March 1863 the 17th North Carolina hovered about the place and made demonstrations upon it, but the regiment retired when the gunboats came up from Albemarle Sound. The gunboats had been relied upon to hold the place, but it was now strongly fortified on the land side and garrisoned, and early in April 1864 was held by Gen. H. W. Wessells, with four regiments of infantry, detachments of cavalry and artillery, in all about 3,000 men. As before, the principal reliance for the defense of the place was the navy.

In the spring of 1864 the Confederate authorities at Richmond determined that an attempt should be made to recapture Plymouth, and Gen. R. F. Hoke was put in command of a division for that purpose, and was to be assisted by Capt. J. W. Cooke of the navy, with the *Albemarle* then nearly completed. The *Albemarle* was an iron-clad vessel, similar to the *Merrimac*, carrying two heavy guns, and was built at Edwards Ferry, on the Roanoke, 30 miles below Weldon. She was built in a cornfield, and all the old iron in that section of the country was collected to make her armor. Hoke's division proceeded to the vicinity of Plymouth, drove in Wessell's pickets 17 April, surrounded the place on the land side from the river above to the river below, opened with artillery, made assaults on parts of the line on the 18th, which, with the aid of the gunboats, were repulsed, and prepared to storm the works as soon as the *Albemarle* could clear the river front of the Union vessels protecting the place with their guns. On the 18th the *Albemarle* left Hamilton, passed down the Roanoke and, favored by unusually high water, ran over obstructions placed in the river, ran past heavy shore-batteries, and at 3 A.M. on the 19th discovered the Union gunboats *Miami* and *Southfield* lashed together about half a mile below the town. Capt. C. W. Flusser was in command of the two vessels and had lashed them together with long spars, with chains festooned between them, it being his intention to get the *Albemarle* between the two vessels, which would have placed the Confederate vessel at a great disadvantage. Cooke avoided this by running the *Albemarle* close to the southern shore, and then, suddenly turning toward the middle of the river, dashed obliquely into the side of the *Southfield*, the long knife-like prow of the *Albemarle* penetrating 10 feet, making a large opening into the side of the *Southfield* and carrying her to the bottom within a few minutes, with a part of her crew. The *Albemarle's* prow had become entangled with the *Southfield*. The *Miami*, close alongside, opened with her heavy guns, and a shell fired by Flusser struck the *Albemarle*, rebounded and exploded, killing Flusser instantly. Lieutenant French took command, and attempted to board the *Albemarle*, but was repelled, and the *Miami* withdrew from the contest and ran down into Albemarle Sound. Next morning the *Albemarle* opened fire upon the forts and works near the river, and Hoke, moving around to that side, attacked the works. After being several times repulsed, he carried them, Wessells surrendering his entire command. In killed, wounded and captured the Union loss was 2,834 men. The Confederate loss is not fully known, but Ransom's brigade alone suffered a loss of about 500 killed and wounded.

Soon after the capture of Plymouth General Hoke was ordered to the army in Virginia, but the place was held by the Confederates in some force, aided by the *Albemarle*. On 5 May 1864 the *Albemarle*, with two other vessels, ran down the river into Albemarle Sound and engaged a Union fleet of seven vessels, inflicting much damage, and returned to Plymouth. There was no Union ironclad that could cross Hatteras Bar and enter the North Carolina sounds, no other vessels could cope with the *Albemarle*, and it was reserved for Lieut. W. B. Cushing (q.v.) to execute a plan for her destruction. On the night of 27 Oct. 1864 he entered Roanoke River with two steam lauches, each carrying a 12-pound howitzer and a torpedo. The launches carried 20 men, well armed with revolvers, cutlasses and hand-grenades. Passing near the pickets on the shore, Cushing approached the *Albemarle* at 3 A.M., and was hailed and fired upon with musketry from the shore and the vessel. Discovering that there was a circle of logs around the ship and about 10 feet from it, he turned back, and when about 100 yards away again turned, at full headway struck the logs and slid over them, and, in face of a crashing fire of canister and musketry, exploded a torpedo under the vessel and tore a large hole in her, "big enough to drive a wagon in," her commander says, and she soon settled to the bottom. Cushing with his men took to the water, he and one or two others escaping, while two were drowned and 11 captured.

On the 29th October Commodore Macomb, with his fleet, went up Roanoke River, and, arriving at the wreck of the *Southfield*, exchanged shots with the Confederate batteries, but finding that the channel of the river had been effectually obstructed, he returned, next day went by way of Middle River into the Roanoke, and on the morning of the 31st engaged the batteries on shore, which were supported by musketry from rifle-pits and houses. After an hour's contest, in which 10 vessels were engaged, a Confederate magazine was blown up; the works were abandoned, and the Union forces took possession of the town. Consult 'Official Records' (Vol. XXIII); 'Naval War Records' (Vols. IX and X); the Century Company's 'Battles and Leaders of the Civil War' (Vol. IV); Soley, 'The Blockade and the Cruisers.'

E. A. CARMAN.

PLYMOUTH BRETHREN, a religious sect which had its rise in the British Isles about 1827, when the Rev. John N. Darby, a minister of the Episcopalian Church of Ireland, associated himself with a group of dissenters in Dublin and formed a religious society of Brethren on a platform of Evangelical Calvinism. Similar local societies existed in various towns of Ireland and England, and Darby, while visiting the society at Plymouth, won over to his views a large number of persons, among them two or three clergymen of considerable distinction, one of them the Rev. Benjamin Wills Newton, another the Rev. James L. Harris, and the third the noted Biblical scholar, the Rev. Dr. Samuel Prideaux Tregelles. Plymouth now became the principal centre of the movement, and hence the popular title of the sect, Plymouth Brethren: the official title is "Brethren" or "Christians." A weekly newspaper was edited by Mr. Harris, and the sect made rapid progress, congregations being formed in every considerable town in England. In 1838 Mr. Darby went on an evangelizing mission to Switzerland and spent seven years in that country, chiefly in French Switzerland, where his success in gaining disciples and forming congregations was extraordinary among the Methodists and other dissenters: in Germany, too, in German Switzerland, in Italy and in France his opinions were received with no small favor: but French Switzerland, and in particular Geneva, Lausanne and Vevey, was his stronghold. When he returned to Plymouth in 1845 he sought to depose B. Wills Newton from the headship of the community there, charging him with a disposition to introduce priestly rule; but most of the Brethren upheld Mr. Newton, and Darby thereupon formed a separate assembly. At Bristol in 1848 there was a similar division, but this time into three sects, those siding with Darby, those siding with Newton and those siding with neither. Of these divisions there were subdivisions later. Four divisions of Plymouth Brethren had in the United States churches and membership at last report; Div. I — churches 134, communicants 2,933; Div. II — churches 128, communicants 4,752; Div. III — churches 81, communicants 1,724; Div. IV — churches 60, communicants 1,157. The Plymouth Brethren hold that an official ministry is an unchristian institution; among them all the male members are on an equal footing, and have the right to exhort in the meeting; after the opening exercises — a hymn or prayer — there is usually a pause to wait for volunteer addresses. See RELIGIOUS SECTS.

PLYMOUTH CHURCH, a church in Brooklyn, N. Y., of which Henry Ward Beecher was pastor for 40 years (1847–87). The church was organized in 1847; the present church building was erected in 1849. Dr. Beecher was succeeded by Lyman Abbott, who was succeeded in 1899 by Newell Dwight Hillis. The church membership is about 2,200.

PLYMOUTH COLONY, The. See MASSACHUSETTS, *History;* MAYFLOWER, THE.

PLYMOUTH COMPANY, The, in American history, a company formed in the 17th century, of Plymouth and Bristol merchants, and also called the North Virginia Company. It was incorporated in 1606, and obtained a charter from James I, with grant of land between Long Island and Passamaquoddy Bay. This company was the rival of the London Company. In May 1607, two ships were despatched to America bearing a company of colonists commanded by George Popham. An abortive attempt at permanent settlement was made on the Kennebec River, but Popham died and the remaining colonists returned home. The company still continued to exist till its reorganization in 1620 as the New England Company or Council for New England.

PLYMOUTH ROCK. See Mayflower, The; Plymouth, Mass.

PLYMOUTH ROCK, a fowl. See Poultry.

PLYMOUTH SOUND. See Plymouth, England.

PLYMPTON, plĭmp'tŏn, **Almira George,** American author: b. Boston, Mass. She was educated in the private schools of Boston and has gained a reputation as an author of juvenile books. Among them are 'A Willing Transgressor'; 'Penelope Prig'; 'Rags and Velvet Gowns'; 'Gerald and Geraldine'; 'In the Shadow of the Black Pine.'

PLYMPTON, George Washington, American engineer and educator: b. Waltham, Mass., 18 Nov. 1827; d. 11 Sept. 1907. He was graduated from the Rensselaer Polytechnic Institute, Troy, N. Y., in 1847, and was professor of engineering and architecture at the University of Cleveland in 1852, professor of mathematics at the New York State Normal College, Albany, in 1853–56, and in 1857–63 occupied the chair of physics and engineering of the State Normal School, Trenton, N. J. He was professor of physics and engineering at Cooper Union, New York, from 1869 and director of the night school from 1879. He was also professor of physics and engineering at the Brooklyn Polytechnic Institute from 1863, professor of chemistry and toxicology at the Long Island College Hospital 1864–86, editor of Van Nostrand's *Engineering Magazine* in 1870–86, and published 'The Starfinder' (1878); 'How to Become an Engineer' (1892), etc.

PLYNLIMON. See Plinlimmon.

PNEUMATIC BUFFER, a mechanism consisting of a cylinder and piston, or of a series of cylinders and pistons, employed for various purposes, but more especially to absorb the recoil of large pieces of artillery, and to absorb the shock of falling elevators, printing presses, etc. The arrangement of pistons and cylinders varies according to the type and purpose of the engine to which the buffer is attached. The object in every case is to absorb sudden shocks and jars which otherwise would quickly wreck costly apparatus. The principle of the buffer is the transmission of the shock to the piston-rod, which thereupon forces the piston-head against the volume of air within the cylinder. The air is compressed and absorbs some of the shock, while graduated holes in the cylinder permit the air to escape slowly, and gradually the piston and load behind it are brought to rest. See Air-Cylinder.

PNEUMATIC CLOCKS. See Clocks.

PNEUMATIC DESPATCH. See Pneumatic Tubes.

PNEUMATIC TIRE. See Bicycle; Automobiles.

PNEUMATIC TOOLS are a class of portable mechanical appliances operated by compressed air. The air pressure is conveyed through a flexible tube from a pressure tank to a miniature self-contained motor, and the tool is adjusted and applied by the hand. They are of two types — percussion and rotary. In the former the work is accomplished by rapidly repeated blows and in the latter by a boring action. They are used for a great variety of mechanical operations, such as drilling, ramming, hammering, riveting, caulking, boring, screwing, expanding boiler tubes and carving. A good representative of the percussion tools is the pneumatic hammer. It consists of a cylinder in which a piston works with a reciprocating (back and forth) action, actuated by compressed air admitted to and exhausted from the cylinder by suitably arranged openings.

A loose-fitting tool (such as a rivet-set, in case the appliance is employed as a riveter) is inserted in the front end of the cylinder, to which the compressed air is conveyed by flexible hose connections, and through the handle at the rear. To operate, the device is held by the handle and the tool is pressed firmly against the work. The operator then admits the air-pressure into the cylinder by pressing on the throttle lever, and starts the reciprocating hammer, which strikes the tool or rivet-set at each forward stroke. The action is similar to that of driving a chisel with a mallet or hammer, with the exception that the successive strokes are delivered with great rapidity, at a rate of speed as high as 20,000 blows per minute, and sound like a continuous buzz, the efficiency of the appliance being due to the frequency of the strokes rather than to the power of each individual stroke. Pneumatic percussion tools, in general, are made small enough to be operated by the hand, and they are adapted for various uses by simply replacing the tool piece at the front by other tools specially shaped to fit the particular kind of work. The arrangements for actuating and controlling the piston vary greatly in the different makes, but all of them belong to either the valve or the valveless form.

In the valve-hammers, a reciprocating valve acts in combination with the piston and regulates the admission and exhaust of the compressed air. They deliver a long stroke at a speed ranging from 1,500 to 3,500 blows a minute with great power, and are suitable for heavy riveting, chipping and caulking purposes. In the valveless hammers, the striking piston acts as a valve and controls the admission of the air-pressure to the alternate ends of the cylinder. They deliver a short stroke at a very high rate of speed, generally over 15,000 blows a minute, and are suitable for stone carving, beading flues, light caulking and other purposes requiring a light chipping action. Owing to their simpler construction, they last longer than the valve hammers and are more economical in air consumption relative to the number of blows delivered. For clipping purposes, the speed is greatly reduced, and the piston is constructed to act on a hinged link so as to impart a pincer-like action to the clipping jaws. As riveters, they range from the portable sizes to heavy stationary machines. Any ordinary pneumatic hammer may be employed in riveting, but such work is better accomplished, generally, by the regular U-shaped riveter designed for that purpose. (See Metal-working Machinery). In riveters the compressed air is used at a pressure of 125 pounds to the square inch, while in the other forms the intensity is somewhat less, generally about 90 pounds to the square inch. Rotary pneumatic tools are commonly known as portable pneumatic drills. In wood-working, they are used for boring and drilling; in metal-working, they are employed in the operations of tapping, reaming, screwing nuts on bolts, boring cylinders, expanding tubes, turning crank-pins, cleaning castings, grinding steam-pipe joints, etc. They are made in a large number of sizes, ranging from the light forms used for boring small holes up to the large machines requiring a two or three-horse-power motive energy. Originally they consisted of a small rotary engine with an attached feeding mechanism. Subsequently, to avoid the consequent waste of power, small reciprocating engines were designed, bringing them to the present form, in which they are used with marked economy for all purposes where heretofore the hand brace was employed. They are made in two forms — with single-acting or with double-acting oscillating cylinders, and work with an air-pressure ranging from 70 to 85 pounds to the square inch. In the former, the motor consists of two pairs of single-acting cylinders coupled to the opposite ends of a crank-shaft, the pinions of which gear with the spur-wheels on the tool-shaft. The whole mechanism is enclosed in a cylindrical metallic case. In the latter, two double-acting oscillating cylinders are geared to a crank-shaft carrying a single pinion which gears with a spur-wheel on the tool shaft. Another form — the Boyer piston drill — consists of a motor in the form of an oscillating engine composed of three single-acting cylinders carried in a rotary frame. The pistons being attached to a fixed shaft, the frame is caused to rotate by suitable gears and imparts its motion to the tool-shaft. The compressed air connections are flexible hose similar to those used in the percussion tools. Other forms of pneumatic tools of special application are the hoist, jack, stay-bolt cutter, mud-ring riveter, «bull-dozer» press, paint sprayers, sheep shearers and sand blasts. Their names define the purposes for which they are used. The hoist has largely replaced the ordinary hoisting chain; the jack is a modification of the hoist and is used by being placed under the piece to be lifted. Pneumatic tools are of modern origin and have been principally developed in the machine-shops of the United States, especially in connection with the repair departments of the railroads, but they are being rapidly introduced in European and other countries.

PNEUMATIC TUBES. Pneumatic tubes are employed to despatch letters, parcels, telegrams, etc., to a distance by the energy of compressed air. Their application was originally suggested by Denis Papin in 1667, when he read a paper before the Royal Society of London, describing a plan by which the air in a tube was exhausted in such a way that the piston working in the tube would be drawn in the direction of the suction, pulling with it an attached carrier. His idea was taken up and developed by several inventors, with more or less success, up to 1854, when the Electric and International Telegraph Company, of London, built in that city the first pneumatic despatch system which was actually operated for commercial purposes. It consisted of a lead tube 220 yards in length and one and one-half inches in diameter, in which the carriers were propelled in one direction only. Subsequently, the diameter of the tubes was increased to two and one-fourth inches, which were arranged to send the carriers in two directions — onward from, and inward to, the central station. At the latest report the English Postal Department operates about 601 miles of tubes, 40 miles of which are situated in the London district. In the English system the tubes radiate from the central station to the branch stations located at various points, the larger stations being equipped with two tubes — one for outward and one for inward traffic, while the smaller stations carry on the work through a single tube. The outgoing carriers are propelled by pressure and the incoming carriers are drawn in by the suction of a vacuum. The standard pressure used is about 10 pounds to the square inch, and a vacuum of about six pounds to the square inch, giving about the same speed in both directions. The tubes consist of lead pipes one and one-half inches to two and one-fourth inches in diameter, for interior use, such as the delivery of telegrams and parcels of small size, such as cash-carriers in stores, from one room to another in the same building; while the underground or street tubes are larger, ranging from two and one-fourth inches to three inches in diameter. The two and one-fourth-inch pipes weigh about eight pounds per linear foot and are made in lengths of 28 feet. When installed, they are enclosed in a cast-iron pipe three inches in diameter, made in sections of nine feet. The air-pumps are driven by steam-engines or by electric motors; those in the London district are worked by four 50 horse-power steam-engines. All of the carriers have gutta-percha bodies covered with felt, and are provided with buffers or pistons of felt attached to the front ends, which fit tightly in the tubes. The ends of the carriers are closed by elastic bands to prevent the messages from falling out, but they can be stretched sufficiently to allow the insertion of the message forms. The despatching and receiving apparatus originally consisted of a very complicated double-sluice valve, but it has been superseded by the D-box, a contrivance much simpler in form, which allows communication at will with either the pressure or vacuum mains, so that it is available for both sending and receiving. The carriers run at a speed of about 25 miles an hour.

In Germany, the Siemens system is employed. Its first extensive use was made in Berlin, in 1865, when 5,670 feet of wrought-iron tubing, two and one-half inches in diameter, were laid and connected the telegraph station with the Exchange. In this system, the tube forms a complete circuit, into one end of which the air is introduced under pressure while it is exhausted at the other end, thus maintaining a constant circulation, and also enabling the inserting and despatching of the carriers without temporarily shutting off the air current. The carriers were stopped at intermediate stations by placing a wire screen across the tube. The sending and receiving apparatus was constructed of two short pieces of tubing attached to a rocking frame so that either of them could be swung into the main circuit by the hand, whenever desired. One of them was open at both ends, and was used in sending; the other was provided with a wire screen at one end, and when swung into the line of the main tube, allowed the air to pass through but stopped the carrier. At the present time, Berlin has in operation about 30 miles of tubes serving about 40 stations. As in the first experimental line, the tubes are laid in circuits, each of which serves a certain number of stations, but the air instead of being kept in constant circulation is stored up in large tanks, and turned into the tubes whenever it is required to despatch a carrier. Paris and Vienna have systems similar to that of Berlin. The carriers are run in trains, despatched at 15 minute intervals, with a maximum speed of 23 miles an hour. They stop at all of the stations on the circuit so that the carriers belonging to each station can be taken off, and those for the succeeding stations put in.

In the United States, the first attempt to establish a pneumatic despatch system was made by Beach, about 1872, who undertook the construction of a tunnel six feet in diameter, under Broadway, New York City. His system was called the "atmospheric railway" (q.v.) and contemplated the running of a car capable of seating 10 persons, through the tube, by the propelling energy of air pressure generated by a revolving fan. The project was abandoned after the completion of a small section of the tunnel. In 1904 the systems installed by the United States Post Office Department were as follows: The Philadelphia lines connecting the city post office with the Bourse, a distance of 2,974 feet, and its extensions to the terminal stations of the Pennsylvania, and the Philadelphia and Reading railroads, a total distance of about one and one-half miles; and the New York City lines, connecting New York City post office with that of Brooklyn, and with the Grand Central Station and the intermediate postal sub-stations, a total distance of about 10 miles. The installation is on the plan of the Batcheller system, very similar to that employed by the English. Compressed air at pressures ranging from 5 to 10 pounds per square inch is forced through wrought-iron tubes ranging from six to eight inches in diameter. They are laid in double lines so as to allow traffic in opposite directions, and are provided with automatic sending and receiving apparatus at all stations. In addition to the lines operated by the government, they are extensively used by private concerns in a great many cities, of which the systems operated by the Western Union Telegraph Company in New York City and Chicago are the most important. Since the perfection of automobile delivery trucks, city transportation has so improved that there is a tendency to discard pneumatic delivery for mail.

Bibliography.— More detailed information may be obtained from the following named publications: 'Pneumatic Tube Service' (published by the Postmaster-General, Washington); Batcheller, 'The Pneumatic Despatch System'; Kemp, 'Year Book' (London 1902); and various publications on the subject by the British Postal Service.

PNEUMATICS, a former name for the science that discusses the properties of gaseous fluids both at rest and flowing, also the properties of solids when the latter are immersed in gases. See CRITICAL POINT; GAS, NATURAL; GAS POISONING; GAS PRODUCER; HYDRODYNAMICS; LIQUEFIED AND COMPRESSED GASES.

PNEUMOGASTRIC NERVE, the vagus, or 10th cranial nerve (see CRANIAL NERVES), the lung-stomach nerve. It is formed by the junction of from 10 to 15 filaments which arise in the medulla oblongata. They form a flattened band which passes out through the skull with other nerves and pursues its course down the neck behind the carotids, being in the same sheath. Below the clavicle the right and left pneumogastrics go in different directions. The right pneumogastric enters the chest-cavity in front of the subclavian artery, gains the back part of the root of the right lung, breaks up into a coarse series of branches, being joined by the sympathetic, and forms the posterior pulmonary plexus. From this two cords of nerve-tissue continue downward on the right side of the œsophagus. An œsophageal plexus is formed about this tube, into which fibres from both sides enter. The fibres then converge to form a single trunk; this passes through the diaphragm and spreads out on the posterior surface of the stomach. The left pneumogastric passes into the thorax between the left common carotid and left subclavian arteries. It forms a plexus for the left lung corresponding with the right side. Its terminal branch passes in front of the œsophagus, and is finally distributed to the front portion of the stomach. The nerve contains both sensory and motor fibres and its function is complex. It is concerned in the functions of the lower part of the œsophagus. It is the important nerve of respiration; is the great cardiac regulator; and is the chief motor nerve of the stomach.

Diseases of the pneumogastric are comparatively rare, but by reason of its wide distribution, and because many of its fibres are distributed to a great number of structures, partial affections are not uncommon. The pharyngeal branches are occasionally involved in diphtheria and in nuclear disease. The pharynx becomes immovable and anæsthetic. Food may lodge in the gullet or enter the windpipe, causing coughing and strangling. Sometimes fluids regurgitate through the nose. In the larynx paralysis of the fibres may produce a confusing series of symptoms, with cough, diminution or loss of voice, hoarseness, impairment of respiration, pain, etc. The specialist is alone able to determine which branches are involved. Affections of the pulmonary branches affect the nutrition of the lung, pneumonia usually resulting from destruction of the vagus. Protracted hiccough is an affection of the vagus, as is also bronchial asthma. Unusual rapidity of the heart action (tachycardia) is due to temporary loss of control of the vagus on the heart. Cardiac palpitation is due to much the same agency; it is frequently associated with impaired stomach functions and is very frequent in hysterical and neurasthenic affections. An abnormally slow pulse (bradycardia) is usually due to an excess of stimulation of the vagus. Angina pectoris (q.v.) is a severe and usually fatal affection implicating the pneumogastric nerve. The involvement of the gastric branches may result either in loss of motion or sensation or excess of each. Sobbing and vomiting are largely induced by excessive irritability of the vagus. Gastralgia is also associated with disorder in this nerve. Loss of function may result in serious impairment of motion and secretion, although the sympathetic nervous system makes an important part of the nervous supply of the stomach. See HEART; STOMACH. And consult works referred to under these articles.

PNEUMONIA. See LUNG, DISEASES OF; PATHOLOGY.

PNOM-PENH, pnŏm-pĕn', Indo-China, capital city of Cambodia, 140 miles northwest of Saigon, on the confluence of the Me-Kong and the Ton-le-Sap, lying partly in the plain and partly on a slight elevation, from which it gets its name, signifying in the vernacular «hill of abundance.» It is the commercial centre of Cambodia, being situated near the Buon Phlau or Quatre Bras, the meeting place of Cambodia's four water ways. A palace of the king, and almost royal dwellings of the Buddhist priest, as well as the home of the French resident, are on the hill; the low ground near the river is occupied by native huts. The main commerce of the city is carried on by the Chinese. Pop. 62,255.

PNYX, nĭks, in ancient Greece, a hill in Athens where the people assembled to make decrees, pass laws, etc.

PO, pō (ancient PADUS, or ERIDANUS), the largest river of Italy, in respect both of its length and its volume of water. It rises on the confines of France and Piedmont in Mount Viso, one of the Cottian Alps, and flows rapidly eastward through Piedmont in the character of a mountain torrent, till, after having been augmented by several other mountain streams, it reaches Lombriasco. Here it begins to move more slowly and after passing Turin, becomes somewhat sluggish. It again flows eastward to the Adriatic Sea. It is about 400 miles long, and its drainage basin covers the larger part of northern Italy. In its lower course its banks are protected by levees and dikes, as the surface of the river is higher than the surrounding country. A number of rivers, chiefly from the Alps, flow into the Po. Its principal affluents are, on the left, the Clusone, Sangone, Dora-Riparia, Stura, Dora-Baltea, Sesia, Agogna, Terdoppio, Ticino or Tessin, Olona, Lambro, Adda, Oglio and Mincio; on the right, the Vraita, Tanaro, Scrivia, Trebbia, Nura, Taro, Parma, Enza, Secchia and Panaro. It drains the famous Lake Como, also Maggiore, Iseo and Garda. Pavia, Milan, Mantua, Parma and Modena are all located in its tributaries. After receiving the Adda its average breadth is about 650 yards. Below Piacenza, which it passes on the right, it is confined by artificial embankments, which are said to have originated with the ancient Etruscans, and notwithstanding the immense sums which have been expended upon them, and the engineering skill which has been exerted in order to render them perfectly secure, the most disastrous inundations have repeatedly taken place. The embankments themselves have added to the danger. The deposits made by the river are perpetually tending to raise the level of the water. This makes it necessary to make a corresponding increase in the height of the embankment, and the effect of these combined operations has been to lift the river so high above its natural bed that it is actually on a level with the tops of the houses in the city of Ferrara. The Po is well supplied with fish, including, among others, the shad, salmon and sturgeon. The deposits brought from the mountains are increasing the extent of the delta, which advances into the Adriatic at the rate of 200 feet each year.

PO RIVER, Engagement on. After two days' terrific fighting in the Wilderness (q.v.), with a loss of over 17,000 men, General Grant concluded to continue the movement by the left, and on the evening of 7 May he put his army in motion for Spottsylvania Court House. The Second Corps, under General Hancock, the last to move, reached Todds' Tavern about 9 A.M. of the 8th and intrenched, being on the right of the army. A reconnaissance to Po River, two miles distant, developed Confederate cavalry on the opposite bank. On the 9th Hancock moved up to the right of Warren's Fifth Corps and took position and intrenched on high ground overlooking the Po and the Shady Grove road. The left of General Lee's line rested on a bend of the Po, and as reports indicated that he was moving in the direction of Fredericksburg, Hancock was ordered to examine the stream with a view to crossing it and making a reconnaissance along the Shady Grove road on Lee's left, crossing the river again by the Shady Grove or Block House bridge, or below it, in order to turn and attack Lee's left. The stream, some 50 yards wide, was crossed by Barlow's, Gibbon's and Birney's divisions late in the afternoon, Birney meeting a stubborn resistance from cavalry and a battery. After crossing, three pontoon bridges were laid and the troops were pushed toward the Block House bridge, Barlow in advance, but night coming on compelled a halt until morning, with Barlow's skirmishers close to the bridge. The orders for the 10th were that, while the rest of the army felt the Confederate position in front, Hancock was to ascertain the position and force of the enemy in his front and the location of his left flank and to hold his corps ready to advance. At daybreak Hancock made a close examination of the Block House bridge with the design of carrying it by assault, but the Confederates (Mahone's division) had been sent to that point during the night, and had intrenched, commanding the bridge and its approaches. Therefore Brooke's brigade of Barlow's division went down the river to find a crossing and General Birney sent two regiments out on the Andrews Tavern road to cover Brooke's movement. About half a mile below the bridge Brooke threw across a regiment which, after going a short distance, discovered a Confederate line of strong earthworks occupied by artillery and infantry. At this time, about 1 P.M., Hancock received a despatch from General Meade directing him to send two divisions to General Warren's position for an assault with Warren on the Confederate lines at 5 P.M. Gibbon and Birney were withdrawn to the other side of the Po, and as Hancock was to command the movements of Warren's Corps and his own, he accompanied them, leaving Barlow to hold the ground south of the river. When Birney began to withdraw, the regiments he had sent toward Andrews Tavern, having driven back Wade Hampton's cavalry, were attacked by infantry, and this evidence that Barlow was likely to be attacked caused General Meade to order Barlow to be withdrawn, as he did not wish to bring on an engagement south of the Po. Hancock was directed to give the matter personal supervision. It was about 2 P.M. when Barlow began to withdraw, at which time Brooke's and Brown's brigades were south of the Shady Grove road, and Miles' and Smyth's brigades along the road, the left resting on a crest a few hundred yards from Block House bridge. In rear the ground was open back to the bridges and swept by the artillery of Lee's left. As the withdrawal began Barlow was attacked; Heth's Confederate division of three brigades and a battalion of artillery, which had crossed the river below the Block House bridge, attacked Brooke and Brown vigorously as they were withdrawing, and was driven back with severe loss when the two brigades passed to the rear and took position on a wooded crest on the right of Miles. Heth followed closely, Miles and Smyth were now retired to a crest in front of the bridges, and all the artillery, except Arnold's battery, was withdrawn and put in position on the north bank of the river. Heth again attacked Brooke and Brown, and was again repulsed with heavy loss. During the heat of this contest the woods on the right and rear of the two Union brigades took fire and the flames approached so close that upon the second repulse of Heth the brigades were ordered to abandon their position and fell back through the burning forest in good order. They immediately recrossed the river under heavy artillery fire. Many men were killed and wounded, numbers of the latter perishing in the flames. One gun of Arnold's battery, becoming entangled in the woods, was abandoned. Smyth's brigade was now crossed and deployed to protect the crossing of Miles; but before Miles could move the Confederates opened a furious fire of artillery from the front and left. Under cover of this their infantry attempted to cross the open ground in front of Miles, but Miles held the infantry in check, and the many Union batteries on the north side of the river silenced the Confederate guns, and Miles, taking advantage of the repulse, withdrew in order to the two pontoon bridges, one of which was immediately taken up, the other destroyed and the operation on the Po River was closed with severe loss on both sides. Consult 'Official Records' (Vol. XXXVI); Humphreys, 'The Virginia Campaign of 1864-65'; Walker, 'History of the Second Army Corps.'

E. A. Carman.

POA. See Grasses in the United States; Pasture; Prairie, etc.

POACHING. See Trespassing.

POCAHONTAS, pō-kạ-hŏn'tạs, Indian princess: b. Virginia, about 1595; d. England, March 1617. She was the daughter of Powhatan (q.v.), a celebrated Indian sachem in Virginia and chief of the Chickahominy tribe. She discovered the warmest friendship for the English colonists, and undoubtedly did render many services to the struggling outpost. Investigations have, however, cast doubt on the traditional narrative of the rescue by her of Captain John Smith (q.v.). Smith, during his explorations, was taken prisoner by Powhatan, and after six weeks sent back to Jamestown. But he makes no allusion to the familiar story until 1616, when Pocahontas was in England; although in his 'True Relation' (1608) he had testified to her services to the colony. In 1616, in a letter to the queen, he says that "at the minute of my execution she hazarded the beating out of her own brains to save mine." But not until the appearance of his 'Generall Historie' (1624) does the tale appear in full elaboration. It has been thought that Smith's known tendency to embellishment and his desire to satisfy English curiosity led him to interpolate the story. Several writers have, nevertheless, contended for the general accuracy of Smith's account. It is argued, among other things, that it is very difficult to understand Smith's statements in the 'True Relation,' the employment of Pocahontas on difficult missions to the whites, and Pocahontas' own benefactions, such as the supplying of starving Jamestown with provisions, except on the supposition that Smith's narrative is substantially veracious. After Smith had left the colony in 1609 Pocahontas fell into the hands of an English expeditionary party (1613), who kept her as a valuable hostage. Her marriage to John Rolfe (q.v.) was solemnized in presence of the uncle of Pocahontas and her two brothers. This event relieved the colony from the enmity of Powhatan, and preserved peace between them. During her visit to England in 1616-17, Pocahontas attracted much attention, being apparently invested in English minds with quite a degree of royal dignity. She was often called the Lady Rebecca from the name received in Christian baptism. Her remains lie at Gravesend, and the burial is noted in the parish records. Consult Deane's edition of Smith's 'The Relation' (1866); Eggleston and Seelye, 'Pocahontas' (1879); Robertson and Brock, 'Pocahontas and her Descendants' (1887); Poindexter, C., 'Captain John Smith and his Critics' (1893); Fiske, 'Old Virginia and her Neighbors' (1897); Smith, E. B., 'Pocahontas and Capt. John Smith' (Boston 1914).

POCATELLO, pō-kạ-tĕl'lō, Idaho, city, county-seat of Bannock County, on the Port Neuf River, and on the Oregon Short Line Railroad, about 135 miles north of Ogden, Utah. It is in a volcanic region that has been made productive by irrigation. It has large railroad shops, machine shops and stock-yards. There is an extensive trade in mining products, livestock and farm products. It has good banking facilities and a daily newspaper. Idaho Technical Institute and Holy Cross School are located here. The city has a Carnegie library, a modern high school building, and a Y.M.C.A. building. Pop. 11,267.

POCHARD, an English name for the male of a species of sea-duck (*Aythya ferina*), but often extended to both sexes and related species. It very closely resembles the American red-head duck, one of the book names of which is American pochard. The bill is broad and flat at the end with a terminal hooked nail and is less than the head in length. The hind toe bears a prominent flattened lobe. The inferior larynx of the male ducks is of strong bony construction. These ducks inhabit the Arctic regions, but migrate southward in winter to the coasts of Europe. Adults are 20 to 24 inches long and have a wing-spread one-half greater. They are marine in habits, and feed upon crustaceans, worms, mollusks and aquatic plants. The plumage is thick and dense, that of the male pochards being lustrous, darker and more brilliant than the plumage of the female. The pochard is represented in North America by the red-head, canvas-back and scaup ducks (qq.v.) and in Asia and Africa by related species.

POCKET-MOUSE, a small burrowing nocturnal gray mouse of the genus *Heteromys*, which inhabits the arid regions of the southwestern United States and is related to the kangaroo rats and mice. They have cheek-pouches in which the carry into their burrows seeds, etc., for storage preparatory to winter famine.

POCOCK (or **POCOCKE**), **Edward**, English Arabic scholar: b. Oxford, 1604; d. 10 Sept. 1691. He was graduated at Corpus Christi College, Oxford, in 1622; entered the Church in 1629; became chaplain to the English Turkey Merchants in the same year; became lecturer in Arabic at Oxford in 1636 and Hebrew professor 1647; suffered some inconvenience because of his royalist sympathies under the Commonwealth; and lived in comfort after the Restoration. The first English Arabic scholar of note and a great Biblical commentator, Pocock is best known for his 'Specimen Historiæ Arabum' (1649) and an edition of Abulfaragius (1663).

POCOCK, Richard, English Oriental traveler: b. Southampton, 1704; d. 1765. He studied at Corpus Christi, Oxford; took holy orders and was advanced rapidly. He wrote 'Description of the East' (1743); 'Observations on Palestine' (1745); and 'Tours in Scotland' (1887, with biography by Kemp). He became bishop of Meath shortly before his death.

PODAGRA (Greek, "a trap for the feet"), that species of gout which recurs at regular intervals, attacking the joints, particularly the large joint of the great toe, and attended with sharp pain. See GOUT.

PODESTÁ, an Italian word, equivalent in its original meaning to a holder of power or authority. In several of the Italian cities it is applied sometimes to the chief of police and sometimes to the chief magistrate or burgomaster. The office was first established in the 12th century by Frederick I in the principal towns of Italy, and was in the Middle Ages much more important than it is now. The podestà was entrusted almost with dictatorial power, the only limitation being that there was an appeal from his decisions.

PODIATRY (Gr. ποῦς, ποδ, foot, and ἰατρεία, treatment). The art of caring for the feet both to cure and to prevent affections of them, called chiropody formerly (etymology usually given χειρ, hand, and ποδ, foot, as if treatment of hand and foot, but probably from χειρυργ, surgery, and ποδ, foot, euphony leading to the modification of the mid-syllable). The development of the art of caring for the feet has led to the recognition of the necessity not only for a special name but also for the definite evolution and regulation of the knowledge and practice of the art. The care of the feet has taken on a new significance in recent years. A number of serious constitutional diseases, as locomotor ataxia (perforating ulcer), diabetes (gangrene), Reynaud's disease and endarteritis obliterans (dry gangrene), as well as others, may give their first significant symptoms in the feet, so that it is all-important that the real meaning of them should not be missed at the beginning when most can be done for them. The chiropodist had developed from the "corn doctor," but there was manifestly need of more scientific training and more clinical knowledge, and as a consequence of this need the profession of podiatry was created. Like modern dentistry it represents an evolution from unprofessional work to a profession that now does much for the comfort of mankind. Both developments are due to American enterprise and the practical recognition and organization of valuable applications of knowledge.

The law of New York State (1919) regulating its practice defines: "Podiatry shall be held to be the diagnosis of foot ailments and the practice of minor surgery upon the foot limited to those structures of the foot superficial to the inner layer of the fascia of the foot; the palliative and mechanical treatment of deformities and functional disturbances of the feet; but it shall not confer the right to treat communicable or constitutional diseases of the bones, ligaments, muscles or tendons of the foot, or any other part of the body, or to perform any operation on the bones, ligaments, muscles, or tendons of the foot involving the use of any cutting instrument or the right to use any anesthetics other than local." This definition has developed after practical experience with the legislative regulation of chiropody. New York was a pioneer with New Jersey in the recognition of podiatry, but now 20 other States: California, Colorado, Michigan, Minnesota, Nebraska, North Carolina, New Hampshire, Maryland, Virginia, Massachusetts, Illinois, Louisiana, Rhode Island, Connecticut, Ohio, Vermont, Washington, West Virginia, Pennsylvania, Wisconsin and the District of Columbia have State regulation, and the benefit of it is so clear that probably all the other States will enact similar legislation in the next few years. There are colleges of chiropody or podiatry in California, Illinois, Ohio, New York, Pennsylvania and Massachusetts. In New York the educational requirements are three years of high school work, and after September 1921 four years or the equivalent. One year of full time school work or two years of evening classes are now required in the actual study of podiatry (anatomy, physiology, pathology of the foot and the treatment of its affections), and this is to be increased after 1921 to two full years of podiatric training. New York was a pioneer in the foundation of a pedic society, and this example led to the organization of similar bodies throughout the country, so that now 37 States have formal associations for the discussion of the problems of foot troubles and the proper regulation of the relations of podiatry to the community. There is a national association of chiropodists which co-operated with the United States military authorities during the war as to the care of the feet of soldiers. The new profession is represented by two organs, *Pedic Items* and *The Podiatrist*, in which many important articles appear. Many regular physicians, among whom Dr. M. J. Lewi of New York has been a leader, have been co-operating in the development of the new profession, and a number of contributions have been made to the special literature of the subject, including a 'Text Book of Practical Podiatry; Practical Podiatry (contains history of specialty, New York 1918); Surgery with

Special Reference to Podiatry (New York 1917).

James J. Walsh, M.D.,
Author of ‘Makers of Modern Medicine,’ ‘Old Time Makers of Medicine,’ ‘History of Medicine in New York,’ etc.

PODICEPS, or **PODICIPIDIDÆ.** See Grebe.

PODEBRAD, pŏd'yĕ-brăd, **George Boczko,** Bohemian king: b. Podebrad, Bohemia, 6 April 1420; d. 22 March 1471. In youth he favored the Hussite movement, but remained with the moderate party during the reign of Sigismund; after the election of Albert V of Austria as Sigismund's successor he supported the Utraquists; invited Casimir of Poland to become king of Bohemia and compelled Albert to retire to Prague. Albert retained the title of king until his death in 1439 and Lipa was chosen regent of Bohemia. In 1444 after Lipa's death Podebrad became regent during the reign of Ladislaus, Albert's posthumous son, and though the young king came to reside at Prague in 1453 Podebrad continued to wield the authority of a monarch. Ladislaus died in 1457 and in 1458 Podebrad was unanimously elected king. He was crowned in 1459 and proceeded to institute various reforms in the government. In endeavoring to conciliate the Pope he banished the Taborites and other sects from the country, but was excommunicated in 1463, and a German crusade was inaugurated against Bohemia in 1466. Podebrad then recalled the banished Taborites, crushed the insurrection, defeated the German invaders and in order to secure the support of the Poles declared Ladislaus, heir of the Polish throne, his successor, his own sons to retain merely the family estates. He succeeded in firmly establishing his kingdom and died shortly after. Consult Jordan, ‘Das Königtum Georgs von Podebrad’ (1861); Richter, ‘Georg von Podebrads Bestrebungen’ (1863).

PODIUM, a foot-wall; *in architecture,* a low wall, generally with a plinth and cornice, placed in front of a building. A projecting low wall round the interior of a building, as a shelf or seat, and round the exterior for ornamental adjuncts, as statues, vases, etc.

PODMORE, Frank, English psychical student: b. 5 Feb. 1856; d. 1910. He was educated at Oxford, was one of the founders of the Fabian Society and was a member of the Society for Psychical Research. He has published ‘Apparitions and Thought Transference’ (1894); ‘Studies in Psychical Research’ (1897); ‘Modern Spiritualism: a History and Criticism’ (1902); ‘The Naturalization of the Supernatural’ (1908); ‘The Newer Spiritualism’ (1910).

PODOCARPUS, a genus of trees and a few shrubs of the family. The species, of which about 60 have been described, are mostly tropical, distributed in the Australasian Archipelago, adjacent Asia, Japan, the South Pacific Islands, the Andes and in Africa. They are resinous, have fern-like leaves, small monœcious or diœcious flowers borne singly or in spikes either in the leaf-axils or subterminally. The pistillate blossoms are followed by small, berry-like fruits upon thick purple stalks, and subtended by fleshy bracts. The fleshy seed-stalks of some are used for food. In America a few are sometimes cultivated in greenhouses; others are sparingly planted in the South and in California. Well-drained loam suits them. Where indigenous, several species are highly prized timber trees. Of these the best known are probably the following: Totarra or totarra pine (*P. totarra*) which approximates a height of 100 feet and a diameter of 12, is largely used for ship-building in New Zealand where it is native; the gagali (*P. elata*) of Queensland, rises 100 feet, but has a diameter of only about three feet and is used for cabinet work; and *P. cupressina,* a Java species, which approximates 65 feet in height and whose easily polished yellow wood is used for house-building, furniture, etc.

PODOLIA, pō-dō'lĭ-ą, or **KAMENETZ,** kä'mĕ-nĕts, a government of West or «White» Russia, north of Bessarabia and bordering on the Austrian frontier; area, 16,224 square miles. The surface is a table-land, strewn with hills; nearly three-fourths is either arable or available for pasturage. The principal river is the Bug, although the Dniester forms part of the southern boundary. The capital is Kamenetz-Podolsk. It was the scene of serious upheavals in the Great World War, at the close of which it was claimed by the new state of Ukrainia. There is considerable manufacturing; the chief manufactures are flour, sugar, spirits and tobacco products. Pop. 4,127,600.

PODOLSK, a town in Russia, 26 miles south of Moscow. Pop. about 5,000.

PODOPHYLLUM, MANDRAKE, or **MAY-APPLE,** genus of hardy perennial herbs of the family *Berberidaceæ.* The four species are natives, two of China, one of the Himalayas and one of North America. The last species grows about 15 inches tall, bears one or two dark green leaves; in the axil of two-leaved specimens one or sometimes two fragrant saucer-like cream-colored flowers are borne. These are followed by a yellow, tender, insipid fruit which is somewhat edible. The dried roots and a resin obtained from them have been used in medicine, but are less popular than formerly. The fruits are sometimes called wild lemon and hog-apple. The name mandrake (q.v.) is more correctly applied to *Mandragora,* which is the mandrake of ancient history and romance.

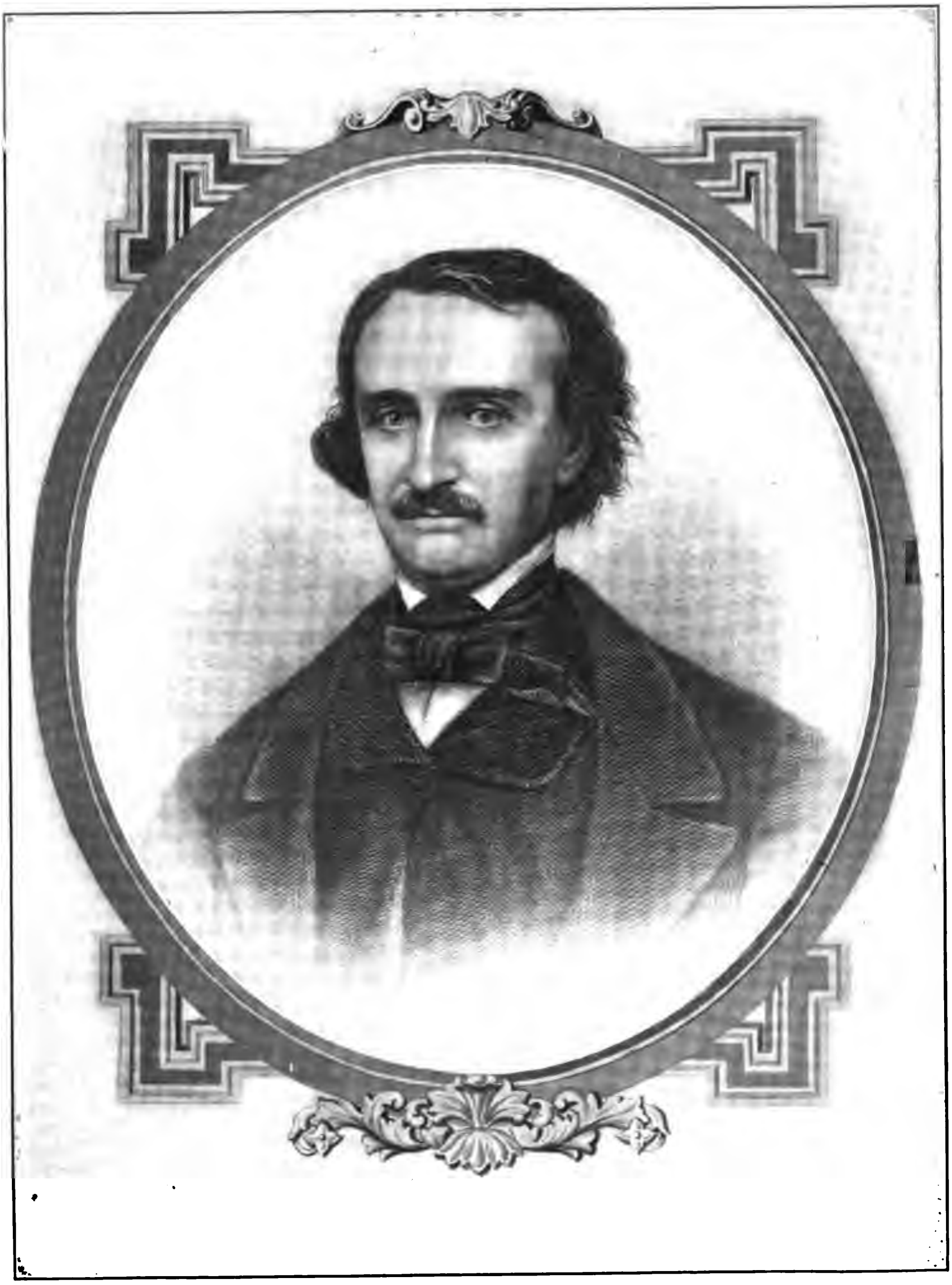
PODURIDÆ. See Bristle-tails.

POE, Edgar Allan, American poet and prose writer: b. Boston, Mass., 19 Jan. 1809; d. Baltimore, Md., 7 Oct. 1849. His father was of a good Maryland family and his mother was a daughter of the once celebrated English actress Mrs. Arnold. Both parents were actors and were engaged at the Boston Federal Street Theatre at the time of their son's birth. Mrs. Poe, who outlived her husband, died in great poverty, leaving three children, who were adopted by friends. Edgar was taken into the home of his godfather, John Allan of Richmond and was treated in many respects as a child of the family. He was a handsome, precocious boy; the over-indulgence and unwise petting of his foster-parents aided in developing a naturally imperious and self-indulgent nature. When he was six years old the Allans took him to England and placed him in a school at Stoke-Newington, then a suburb of London. He remained at the school for six years and there laid the foundation of his curious classical lore. The autobiographical story of William Wilson describes the old Manor House School and its quiet round of duties and pleasures. On his return to Richmond in 1821 he entered the English and Classical School of Joseph H. Clarke where he was prepared for college. He was quick and brilliant, excelling in languages and in athletics. But in spite of his talents Poe was unpopular; his extreme sensitiveness, his moody disposition, his pride of intellect kept his school fellows at a distance. He formed, during this time, a passionate devotion to the mother of one of his schoolmates and after her sudden death spent night after night of a bleak, dreary autumn, by her grave. At 17 he matriculated at the University of Virginia. He devoted himself to Latin, Greek, French, Spanish, Italian and took the highest honors in Latin and French. But his gambling debts were heavy and he was not allowed by Mr. Allan to return. After a short enforced stay in Mr. Allan's counting-house he determined to make his own career and ran away to Boston. There he published his first volume, 'Tamerlane and Other Poems' (1827), verses without any special originality and rough in execution. Poor and friendless he now enlisted in the army. He made an efficient soldier, was promoted to sergeant-major and was so attracted to army life that he again asked Mr. Allan's aid, and, through his influence, was allowed to enter West Point. He disliked the discipline of the school, however, and deliberately gave such grounds for offense that he was dismissed. Just before he entered West Point he had published a second volume of poems containing among others a revision of 'Tamerlane' and 'Al Aaraaf,' and after his dismissal he determined to make literature his profession. A second edition of his poems (1831), in such verses as 'Israfel' and 'To Helen,' gave promise of a real poet. In 1833 he competed for the prize offered by the *Saturday Visitor* for the best short story; and the award was made to 'A Manuscript Found in a Bottle,' one of the six stories which he had submitted. Mr. John Kennedy, the novelist, was one of the judges; he became the warm friend of the young writer and rescued him from deepest poverty by obtaining for him magazine hack work. Poe was at this time living with his aunt, Mrs. Clemm, and her daughter Virginia, in Baltimore, but soon moved to Richmond to write exclusively for the *Southern Literary Messenger*. He gained constantly in reputation and his weird tales and biting critiques rapidly raised the subscription list of the magazine from 700 to 5,000. In 1836 he married his young cousin, Virginia Clemm. Poe's life was restless and stormy; he left one position after another, just as he seemed on the point of a great success; his indulgence in opium and in intoxicants increased and he was often plunged into dire poverty, but his love for his beautiful wife was steadfast. Mrs. Clemm lived with her daughter and took care of the home. His wife was the inspiration of some of his purest poetry, of 'Eleonora,' of 'Annabel Lee,' of 'Lenore.' He uttered his forebodings over her desperate illness in 'The Raven,' and his grief for her death in the tender stanzas 'To One in Paradise,' and in the hopeless 'Ulalume.'

The letters he wrote to his mother-in-law are natural, simple and winning, and show Poe in a most attractive light. To her he wrote also the beautiful lines 'To My Mother.' In 1838 he moved with his family to New York where he held, for a short time, a position on the New York *Quarterly Review*, but the magazine was not so successful financially as had been hoped and Poe entered into an engagement with the *Gentleman's Magazine* and removed to Philadelphia. Mr. William Gowans, a well-known bookseller, who boarded with Mrs. Clemm in New York, gives emphatic testimony to Poe's courtesy and sobriety at this time. In 1839 his best stories were published in two volumes entitled 'Tales of the Arabesque and Grotesque' — among them 'Ligeia,' Poe's favorite tale, and the masterly 'Fall of the House of Usher.' A year later he began his work for *Graham's Magazine* in Philadelphia, and the fame of his poems, stories and critiques, together with Mr. Graham's excellent management, in two years raised the subscription list from 5,000 to 52,000. Much of his best writing was done for this magazine; in it were published among many other stories 'The Murders in the Rue Morgue,' which was immediately translated into French; 'The Descent into the Maelstrom'; and 'The Mystery of Marie Roget.' In 1842, either from native restlessness or because his fits of intoxication were increasing, he resigned the editorship of *Graham's* and two years later again moved to New York. In 1841 Mrs. Poe ruptured a blood-vessel and the next six years were filled with poverty, illness and agonizing alternations of hope and fear. At one time Poe achieved his desire of having a magazine of his own, as he had sole management of the *Broadway Journal*, but he had little executive ability and this enterprise failed. In January 1847 his wife died at Fordham, then a suburb of New York, and after this overwhelming sorrow, for two years and a half he struggled feebly against illness, weakness and opium. His most notable works during this period were 'Eureka,' 'The Bells' and 'Ulalume.' In October 1849 he fell ill in Richmond as he was starting for New York and was found delirious in the streets of Baltimore. He died in the City Hospital and was interred in the burial grounds of Westminster Church, near the grave of his grandfather, General David Poe.

Poe's character was complex and difficult; he was self-willed and self-indulgent, too often regardless of the rights of others, intensely proud and reserved, sometimes courteous and kindly, oftener moody and abstracted. He was keenly sensitive to sound and easily excited by stimulants. That he was not the degraded inebriate that Griswold depicted has been abundantly proved, but there is no doubt that his poverty and his frequent change of promising positions were caused in part by vacillating will and by recurring spells of intoxication. He was a dreamer and his imagination dwelt with the mystic and horrible; his mind was brilliant and acute and his sense of form and proportion exquisite.

The themes of Poe's poetry were few — man's loneliness, the hopelessness of struggle, remorse for a wrecked life. His poems bring no breath from the outer world. Theirs is a



EDGAR ALLAN POE

land of dreams, of tempest, of fantastic terrors, of ashen skies, and through this land glide ghosts, birds of ill omen and crawling shapes. His poetry is not stimulating and has no moral quality; but has frequently an almost faultless literary form, vivid, if distorted imagination, and a haunting melody. His theory was that a poem should have complete unity in itself, and consequently should never be of great length, and that the poet must compose only when in a state of highly excited emotion. Poetry he defines as the «rhythmical creation of beauty.» His fame as a poet rests on a few short poems, 'The Raven,' 'Lenore,' 'Ulalume,' 'The Bells,' 'Annabel Lee,' 'The Haunted Palace,' 'The Conqueror, Worm'; and these in unity of design, in exquisite choice of melodic words, and in concentrated passion are well nigh faultless.

His stories are weird, filled with horrors and often glow with the putrescence of physical decay. They are carefully wrought and in such masterpieces as 'The Fall of the House of Usher,' and 'Ligeia' every word heightens the desired effect. The disintegrating power of fear on a sensitive and highly organized soul has never been more powerfully portrayed than in the former story. Poe's analysis of morbid and tortured souls is unsurpassed. His acute analytical powers are shown in such stories as 'The Murders in the Rue Morgue' and 'The Gold Bug'; his speculations usually hovered about the improbable and the horrible. His originality, his literary craftsmanship, are unquestioned, but he lacked the will and the moral conviction which would have brought his great gifts to their highest fruition. Editions of Poe are numerous. Griswold's (2d ed., 4 vols., New York 1856) contains a biased biography; the Stoddard edition (6 vols., New York 1895) errs in the same regard. Good editions are those of Gill (Diamond Edition, Boston 1874); of Ingram (2d ed., 4 vols., Edinburgh 1880; New York 1894); Harrison (Virginia Edition, notes by Stewart, 17 vols., Boston 1892); Stedman and Woodberry (10 vols., New York 1898). The 'Tales' were translated into French by Baudelaire; and also into German and Spanish. See FALL OF THE HOUSE OF USHER, THE; GOLD-BUG, THE; RAVEN, THE.

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EMILIE WATTS McVEA,
President Sweet Briar (Va.) College.

POE, Orlando Metcalfe, American soldier: b. Navarre, Ohio, 7 March 1832; d. Detroit, Mich., 2 Oct. 1895. He was graduated from West Point in 1856, and in 1861 was chief of engineers in the Department of the Ohio. In that year he was commissioned colonel of the 2d Michigan Volunteers, served in the Virginia and Maryland campaign, was appointed brigadier-general of volunteers in 1862, and in 1863 was mustered out of the volunteer service and became chief of engineers in the 23d corps of the Army of the Ohio. He served in a similar position under Sherman in his invasion of Georgia, and was brevetted brigadier-general in the regular army in 1865. In 1865–70 he was engineer secretary of the United States lighthouse board, engaged in constructing the lighthouse on Spectacle Reef, Lake Huron, in 1873–84, and had charge of various river and harbor works in the Great Lakes. He was a member of the United States board of lighthouse commissioners, aide-de-camp to General Sherman, and at his death was chief engineer of the Northwest district.

PŒCILE, pē'sĭ-lē, a stoa or portico in ancient Athens, containing a picture gallery. The philosopher Zeno (q.v.) taught his doctrines here. See STOICISM.

POEM OF THE CID ('Poema de Mio Cid') is the most ancient monument of Spanish literature. The author, date and place of its composition are uncertain, but internal evidence points to some part of Castile, probably the neighborhood of Medina, as the place and 1140–60 as the date of its writing. The 'Poema' falls thus in time between the 'Chanson de Roland' and the 'Niebelungenlied.' In archaism of diction and prosody it stands nearer its French prototype; in unity of conception and the clean-cut outlines of the development of its story nearer to its German successors. The 3,730 lines of the epic fall into 152 stanzas of very varying length, the lines in each having the same assonant, though not rhyming ending. The metre is a rude Alexandrine, doubtless somewhat corrupted in the single manuscript, written apparently in 1307, which survives. The beginning is lost and a page, some 50 lines, from the body of the book. The theme of the 'Poema' is the wrongs, martial achievements in banishment and final triumphant vindication of Ruy Diaz de Bivar, known to Moors as Sid-i, that is, my Cid, i.e., my Lord, and to his contemporary Spaniards as El Campeador, i.e., the Warrior, German *Kämpfer,* though curiously enough later writers of either race favored the designation given by the other. The historical Ruy Diaz was a Castilian of distinguished birth. His wife, Ximena, was a daughter of Diego, Count of Oviedo. He was banished through court intrigue in 1080 or 1081 and for some years distinguished himself in partisan warfare with and against Moorish chieftains, fought notable battles at Almenara, Zalaca and Tebar, captured Valencia in 1094, formed an alliance with Pedro of Aragon in 1096 and, after five years of troubled rule at Valencia, died in 1099. His wife and followers evacuated that town in 1102. Out of this energetic and successful condottiere legend had in a half century erected a hero of a loyalty to his king as utter and more abject than that of Roland or of the German Hagen, a pattern of valor, of magnanimity and of honor as that age conceived it, but yet a thoroughly flesh and blood man. The 'Poema' opens with the Cid going into banishment. Popular sympathy is repressed by dread of the king. He recruits his finances by cheating a Jew about security for a loan and his forces with «needy men» from all quarters. His wife, a Ximena, though not the true one, and his daughters, creatures of the poet's fancy, are confided to a monastery. He has a comforting vision of the angel Gabriel at Higeruela, captures Alcocer, defeats Moors who besiege him there in an inspiriting battle, but has still to «maintain himself by lance and sword.» At Tebar he defeats the Count of Barcelona and shows to him a magnanimity which challenges his admiration and even belief. Here the Cid won the first of his famous swords, Colada, still shown as a treasure at the Armeria in Madrid. «Here,» says the poet, «begins the *gesta* of My Cid» (line 1086) and with it the epic's second *cantar*, or canto. This tells of the greatest achievement of Ruy Diaz' life, the capture of Valencia and the setting up of his princedom there, interweaving with this the wholly fictitious tale of the marriage of the Cid's daughters, in compliance with the royal desire, to certain Infantes de Carrion. Here is introduced an «Eastern bishop,» Jeronimo, who plays somewhat the part of Turpin in the Roland song. A combat with an uncaged lion seems conscious imitation of a passage in the French epic. Babieça, the steed who plays so large a part in the later ballads of the Cid, also appears. The third and last cantar opens with a fine battle piece and the winning of the Cid's second sword, Tison, still guarded as an heirloom in Spain, but deals chiefly with the bitter despite done to the Cid's daughters by the Infantes de Carrion at Corpes and with their subsequent humiliation and punishment in battle ordeal. It closes with the second and more brilliant nuptials of the daughters with the Infantes of Navarre and Aragon which have historic warrant, for since Alfonso VIII of Castile «kings of Spain are of his blood» (line 3,724) and Charles V in a royal charter of 1541 speaks of the Cid as «our ancestor.» The most scholarly edition of 'Poema de Mio Cid' is by R. Menéndez Pidal (Madrid 1911). The most convenient, also by him, is in the 'Clasicos Castellanos' (Madrid 1913). An edition, in three volumes with text, translation and notes by Arthur M. Huntington, was printed for the Hispanic Society of America in 1897. John Ormsby's 'The Poem of the Cid' (London 1879), has a spirited version of the finer passages, with a much condensed prose rendering of the rest, a good introduction and a table of the ancestors and descendants of the Cid. The relation of the 'Poema' to the facts is fully examined by R. Dozy in 'Recherches sur l'histoire politique et littéraire de l'Espagne pendant le moyen âge' (Leyden 1881). For later developments of the legend consult 'Chronica del Cid,' the basis of R. Southey's 'Chronicle of the Cid' (London 1808), and the more than 200 ballads collected by Duran in 'Romancero general' (2 vols., in 'Biblioteca de autores españoles') and by C. Michaelis in 'Romancero del Cid' (Leipzig 1871).

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POERIO, pō-ä'rē-ō **Carlo**, BARON, Italian patriot: b. Naples, 10 Dec. 1803; d. Florence, 28 April 1867. Having espoused the cause of the Neapolitan liberals in 1828, he participated in the conspiracy of Avellino, and thereby incurred a long imprisonment. He was again imprisoned after the unsuccessful revolutionary attempt of 1847. Liberated in January 1848, in consequence of the revolution begun at Palermo, he organized the historic demonstrations of the 27th of that month, from which resulted the constitution of 10 February, under which he was nominated director of police and minister of public instruction. He soon resigned and was chosen to the Parliament as deputy for Naples. In July 1849 he was charged with conspiracy and, although not justly convicted, was sentenced to imprisonment for 24 years. In 1859 he, with many other political prisoners, was placed on an American ship for transportation, but was landed at Cork and returned, by London, to Turin. In 1860 he was elected to Parliament from Tuscany, and later became vice-president of that body.

POET LAUREATE, an officer in the lord-chamberlain's department of the royal household of Great Britain. The appellation was derived from *laurus*, a bay or laurel, in allusion to the ancient practice of crowning poets with a laurel wreath. Graduates in rhetoric and versification in the English universities were presented with a laurel wreath and were, in consequence, styled *Poetæ Laureati*. The royal laureate was merely one of these in the king's service. The first patent of poet laureate was granted to Ben Jonson in the reign of James I. The laureate was required to furnish an ode on the birthday of the sovereign or on the occasion of a national victory; but this custom was discontinued toward the close of the reign of George III. Since the time of Charles II the following poets have in succession held the office of laureate: John Dryden, Thomas Shadwell, Nahum Tate, Nicholas Rowe, Lawrence Eusden, Colley Cibber, William Whitehead, Thomas Warton, Henry James Pye, Robert Southey, William Wordsworth, Alfred Lord Tennyson, Alfred Austin and (since 1913) Robert Bridges. The salary is $360 yearly.

POET AT THE BREAKFAST TABLE, The, a work by Oliver Wendell Holmes, first printed as a series of papers in the *Atlantic Monthly* in 1872. Like the earlier 'Autocrat' and the 'Professor at the Breakfast Table' it consists of rambling discursive talks on many subjects — religion, science, literature — with a frequent excursion into the realm of philosophy. The principal persons at the table are the Poet; the Old Master, a scholarly philosopher; the Scarabee, a withered entomologist; the poetic young astronomer; Scheherazade, a young girl who writes stories; and the Lady. All of these occasionally take part in the conversation, but more frequently the writer in his own person addresses the reader directly.

POETICS OF ARISTOTLE, The. The 'Poetics' of Aristotle, historically, and doubtless intrinsically, is the most important of extant works in literary criticism. Its relation to prior and contemporary treatises on poetry, including an Aristotelian dialogue 'On Poets,' is uncertain; yet this one surviving «Book» probably contains the net result of Greek reflection upon epic poetry and the drama. It looks like the draft of a lecture, to be amplified in delivery, or else a record of the lecture, made by a student; or possibly a later Alexandrian abridgment of one or more Aristotelian writings on poets and the theory of poetry. With the discussion of tragedy and (partly by implication) epic poetry, we should expect the treatise to include more extended remarks on the effect of tragedy (the «catharsis,» or purging of motion in the audience) and on the nature of comedy. The Aristotelian «purgation of pity and fear» must be partly explained by a study of the actual emotions aroused and allayed in us by the best tragedies. Aristotle's conception of comedy must be inferred partly from scattered allusions in his other works, as the 'Rhetoric'; partly from a few specific references in the 'Poetics,' and from the general implications of that work; and partly from the 'Tractatus Coislinianus,' a garbled fragment on comedy, of Peripatetic, if not strictly Aristotelian, origin.

The history of the 'Poetics' proper down to the 8th century is very obscure. Aristotle's theory doubtless influenced his pupil, the eminent tragic poet Theodectes, and, through another pupil, Theophrastus, probably influenced Menander and the New Comedy. Through a Greek channel such as Neoptolemus of Parium, his doctrines, somewhat altered, found their way into the 'Ars Poetica' of Horace. During the Middle Ages the 'Poetics' was known to scholars in the East, being translated into Syriac in the 8th century. Upon an 11th century translation from the Syriac into Arabic was based the 'Commentary of Averrhoes,' which was rendered into Hebrew, and, by Hermannus Alemannus, into Latin, and through the Latin became known to Roger Bacon and, doubtless, other European scholars. Our earliest Greek manuscript (the best) dates from about the year 1000, but the 'Poetics' was not among the philosophical works which were translated from the Greek into Latin in the 13th century.

In the second half of the 15th century the Greek text was studied, in a number of manuscripts, in Italy. A translation appeared in 1498, and the *editio princeps* in 1508. Through Italian editors and commentators (as Castelvetro) a knowledge of the 'Poetics' was transmitted to other parts of Europe, and therewith sundry misconceptions as to the so-called Aristotelian «rules» for the drama. Thus in the 17th century, French tragic poets, as Corneille and Racine, were obsessed with a belief in the «three unities» of «time,» «place» and «action»; the action of a drama, it was thought, should not only be unified, but should be represented as occurring within the space of «one revolution of the sun,» and all in one place — whereas Aristotle, duly insisting upon unity of action, says nothing whatever about any «unity of place,» and merely notes that the tragic poets of his day (70 years after the death of Euripides) aimed to confine the time represented in a play to «one revolution of the sun,» and that the earlier Greek dramatists did not. Milton, in his conception of the tragic «catharsis,» similarly follows the Italian commentators; the end of tragedy is to stir the mind to pity and fear, and by raising them, «to purge the mind of those and such-like passions»; when he adds, «that is, to temper and reduce them to just measure,» he departs from Aristotle, whose conception was strictly medical — the tragic purge is complete, it leaves no residuum of «purified» fear and pity. The worst misconception, however, was peculiar neither to the Renaissance nor to the Middle Ages. To deem the 'Poetics' a set of «rules» imposed upon the free activity of the poet is a mistake that is made whenever the value of the treatise is dimly discerned, and its firm generalizations are not seen to be mingled with tentative suggestions and casual remarks which sometimes contradict one another. The correct attitude may be seen in Ben Jonson, who says (following Heinsius): «Those that can teach him [the poet] anything he must ever account his masters and reverence; among whom Horace and (he that taught him) Aristotle deserved to be the first in estimation. . . . But all this in vain without a natural wit and a poetical nature in chief; for no man so soon as he knows this, or reads it, shall be able to write the better; but as he is adapted to it by Nature he shall grow the perfecter writer.»

For our own day, the best of modern editors says: «The book, taken as it is, with perhaps an occasional side-light from some of his [Aristotle's] other works, is intelligible enough; after a brief introduction, he gives us in outline all that he has to say on the subject immediately before him, the technique of the drama and the epic. He tells one, in fact, how to construct a good play and a good epic, just as in the 'Rhetoric' he tells one how to make a good speech. And in doing this he has succeeded in formulating once for all the great first principles of dramatic art, the canons of dramatic logic which even the most adventurous of modern dramatists can only at his peril forget or set at naught.»

To Aristotle, Homer is the greatest of poets, but tragedy the highest form of poetry. In tragedy, the nearest approach to his ideal is Sophocles' 'Œdipus Rex,' though he pays much attention to Euripides' 'Iphigenia in Tauris.' With Homer and Sophocles he mentions Aristophanes; though his conception of comedy and tragedy was modified by the practice of his own age, his theory of the poetic art was in the main founded upon a study of these three. Of Æschylus, for some reason, he has little to say. Lyrical poetry he does not discuss, doubtless because to a Greek it fell under the art, not of poetry, but of music.

Aristotle conceives of poetry and the other arts as forms of «imitation.» As a painter imitates a human figure in pigments, or as a sculptor imitates a man in bronze or in stone, so a tragic poet imitates an action — something done or suffered by human beings — in the medium of rhythmical language. This action is the very «soul» of the tragedy; the moral bias of the agents (shown in their habit of choice) is, like their ways of reasoning and explaining, subservient to the plot taken as a whole. The plot or action must be unified and complete — this is the only «unity» demanded by Aristotle. «Oneness» of hero — the only other «unity» mentioned by him — does not make a story an organic work of art. A good story is, in fact, like a living creature, no part of which could be transposed or removed, and to which nothing could be added, without distorting the whole. It follows that the poet (the Greek word means *maker*) is a "maker" of plots rather than a versifier. What counts in the poet, then, is what we should call the constructive imagination. And in the finished work, what counts is the effect of the whole upon the competent judge — the arousal in him of the proper emotions (as by a reversal of fortune brought about through a flaw of character in some hero), and the right sort of pleasure in their relief (when we thrill with fear and melt with pity as the hero moves toward his doom and falls). To Aristotle our pleasure in art is allied to the pleasure we derive from the process of learning in general, and hence he dwells on the importance of "Discoveries" of identity in 'Œdipus Rex' and the 'Odyssey.' Consult Bywater's edition, 'Aristotle on the Art of Poetry' (Oxford 1909) and Cooper's 'Amplified Version' (Boston 1913).

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POETRY. Poetry has been defined in many ways, and in the nature of the case the term means different things under different conditions. In general it may be defined as emotional and imaginative discourse in metrical form; that is, the representation of experiences or ideas with special reference to their emotional significance, in language characterized by imagery and rhythmical sound. On the side of concrete imagery the art of poetry is closely related to the arts of painting and sculpture; but it differs from these in that it is better adapted to the representation of continuity and movement, and also in that it can make use of purely abstract ideas as well as images. On the side of rhythmical sound it is closely related to music; but it differs from the latter in its capacity to represent both concrete and abstract ideas with some exactness. If the subject-matter is viewed by the poet objectively,— as existing outside and apart from his own personality,— the poetry may be narrative or descriptive; if subjectively,— that is, primarily as a personal experience,— the poetry is lyrical. Dramatic poetry combines these two points of view: it is objective for the poet, but presents the material subjectively through imagined personalities. Since poetry may deal with *general* as well as concrete subject-matter, there also occurs a type best called expository or didactic; but this, because of its small use of emotional values and imaginative expression, exists, as it were, close to the borders of prose. Further, on these types, see under LITERARY FORMS.

Poetry is the most primitive of the literary arts; that is, it normally develops before prose literature. Two theories of its origin have been proposed: that it arises from the elaboration and beautifying of prose discourse, and that it arises from emotional utterance in connection with song and dance. The latter view is the more widely held, and appears to be supported by evidence still observable among primitive peoples. That is, primitive man often expresses the emotional aspects of common experiences by means of a kind of communal art which includes music, dancing and simple verse, each element at first inseparable from the others. Indian festival dancer, and groups of singers at negro camp-meetings, still show this combination. As time goes on there is a tendency to differentiate the individual singer, composer or poet from the group, and eventually to differentiate the arts of music, verse and dancing. There is also a marked tendency, as civilization advances, to diminish the physical or sensuous aspects of emotional expression, and to increase the intellectual or reflective; so that poetry, originally existing only for vocal utterance, eventually becomes a thing to be read, and even to be read silently. But the rhythmic form remains as the evidence of its original connection with the other rhythmic arts. The persistence of this element is due, of course, not merely to historic, but also to psychological reasons: for rhythmic form furnishes a means of expressing emotion and at the same time of keeping it in control, and this is an essential condition of art. Moreover, by transforming the movement of ordinary speech, without depriving it of its normal meanings, rhythmic form seems to symbolize that idealization of reality which is another usual condition of artistic expression.

The precise nature of this rhythmic form naturally differs in the case of different peoples and languages, and according as the association between verse and music is more or less close. Thus the rhythms of Greek verse and Greek music appear to have been closely similar, whereas the rhythms of modern English verse and music differ very widely. For the modern Germanic languages, English included, rhythmic form results from the arrangement of speech in such a way that the principally stressed syllables tend to recur at equal intervals of time; the *number* of syllables within these intervals also tends to be constant, but with many exceptions. In the most common type of English verse two syllables normally occur for each measured stress,— that is for each measure or foot,— and the rhythm may be called *double*. Frequently, again, the norm is three, giving *triple* rhythm; less frequently four, giving *quadruple*. If the rhythm tends to open with an unstressed syllable it is called *rising;* if with a stressed syllable, *falling*. The common types of English metre, then, are the double rising, called Iambic; the double falling, called Trochaic; the triple rising, called Anapestic, and the triple falling, called Dactylic. A line of typical verse is made up of a fixed number of these measured stress-units or feet, and thus may be described as "iambic four-foot" (or "four-stress"), "trochaic five-foot" (or "five-stress"), etc. The stanza is a still larger unit of verse-form, being organized by the grouping of a given number of lines, of length either identical or varied according to a regular pattern, which are also usually linked by terminal rhyme,— that is, by the correspondence, in two words, of the accented vowels and all the following sounds. In the Germanic languages rhyme and stanza are the normal accompaniments of lyrical poetry, while "blank verse" (that is, unrhymed continuous verse, usually iambic five-foot) is the common form for epic and dramatic poetry; in French poetry rhyme is used more insistently, even in dramatic verse.

Greek Poetry.— In the classical age of Greek literature, the 5th century B.C., a high degree of literary development had already taken place, yet at the same time the close connection of the three rhythmic arts remained conspicuous, as is evidenced by the fact that the lyrical odes of Pindar and the dramatic odes of Æschylus and Sophocles were written for musical performance in connection with processional or dance movements of the singers. The Greeks divided their poetry into three chief classes, epic, dramatic and lyric, the third class including subtypes called elegiac. iambic and melic (for an account of these see under LYRIC POETRY), all of which were characterized by different kinds of musical accompaniment. It happens that the body of surviving epic and tragic poetry of the Greeks is more complete and representative than that of their lyric poetry; but it is doubtless not for this reason alone that their epic and tragedy have largely influenced the great body of modern poetry, whereas their lyrics have exerted no such influence. For the Greek epic deals with story material which has remained impressively interesting, and the best Greek tragedies are concerned with emotional and spiritual problems of lastingly vital character; whereas the Greek lyrics are centred more in local and temporary matters, and also lack, for the most part, the subjective and spiritual qualities which are valued in modern lyric poetry. In the later age of Greek literature centring at Alexandria in the 3d century B.C., a new type of poetry was developed, the Pastoral, dealing with the environment and loves of real or imaginary shepherds,— a type widely imitated in succeeding ages.

Latin Poetry.— In the classical age of Roman literature, the 1st century B.C. and the 1st A.D., poetic composition was more largely confined to conscious imitation than in any other important period, and the poetic types of the Greeks became the types of Latin poetry. Certain differences of emphasis, however, naturally developed. Thus dramatic poetry occupied a much less important place than in Greece, while satiric, which by the Greeks was viewed as a minor form of the lyrical group, became highly important; indeed it is the Romans who gave us the type name Satire and who elevated the form, in the work of Horace, Persius and Juvenal, to one of prime significance as an expression of the spirit of their race and age. Another distinctive achievement was the elevation of expository or didactic poetry in Lucretius's great work, 'De Rerum Natura,' which remains the world's chief masterpiece of philosophic poetry.

Mediæval Poetry.— The poetry of the Middle Ages (that is, about 400 to 1400 A.D.) is divisible into two great classes, that arising from the mass of the people in the vernacular languages and that proceeding from the cultivated classes for whom Latin was the literary tongue. In the former class, narrative poetry takes an immensely preponderant place, developing on popular lines, especially those of the metrical romance, independent of literary tradition. It is to this vernacular poetry that we chiefly turn for the expression of that naïve or child-like spirit which is associated with the mediæval "age of faith" or "age of wonder,"— the purely popular poetry of earlier ages being largely lost. Mediæval Latin poetry, on the other hand, follows certain elements of the classical tradition, but is especially marked by the influence of the Church. Hence a number of new poetic types, most of them characterized by a large didactic element: in place of the national epic, religious epic and legend; in place of the lyric of love or wine, the hymn; and above all, appearing in many different types, the allegorical poem,— for the method of allegory is especially characteristic of the effort of mediæval Christianity to interpret all matters of this world in terms of the spiritual realm.

Renaissance Poetry.— The poetry of the Renaissance (that is, generally speaking, the period beginning in the late 14th century in Italy and the late 15th century in western Europe) is characterized by a turning away from the methods of mediæval literature, particularly allegory and didacticism, and a fresh interest in the types and methods of classical poetry, particularly Latin. Hence the effort to revive the formal epic and the formal satire; the imitation of the poetic tragedies of Seneca; a considerable development of pastoral poetry; and the revival of unrimed verse in various metres imitative of those of Greek and Latin. One notes also the saturation of poetry with the old pagan mythology, and a tendency to devote the art to the things of this world as distinguished from those of the spirit. A new type of lyric came into prominence, devoted to courtly love, for which the sonnet form was chiefly used; this fashion arose in Italy and spread to France, Spain and England.

Neo-Classical Poetry.—The principal European literatures were dominated, in the 17th and 18th centuries, by what may be called the neo-classical doctrines, which emphasized the theory and form, rather than the inspiring spirit, of ancient poetry. Poetry, in this school, was treated as a formal art, based on reason and on rules, with diminished emphasis on the elements of emotion and imagination; its spirit is well represented by Boileau's *Art Poétique* (1674) in France and Pope's *Essay on Criticism* (1711) in England. These poems also exemplify the revival of the didactic type, now frequently equivalent to the prose essay. Satire, formal epic and formal tragedy, are again characteristic of this age, as of the Renaissance; while in lyric poetry the more sentimental types, like the sonnet, tend to disappear and the more intellectual and elaborate, like the formal ode, to become prominent.

Poetry of the Romantic Movement.— The latter portion of the 18th century and the early portion of the 19th were characterized, throughout western Europe, by various tendencies commonly summed up in the vague term, "the revival of romanticism." The following are some of the marks of this era affecting the development of poetry: (1) A new emphasis on the lyrical, subjective and spiritual elements of poetry, with a disposition to view its imaginative processes as existing not merely for the sake of pleasure, but for the pursuit of truth by means of the higher intuitions of the mind. Important representatives of this aspect are Jean Paul Richter and his followers in Germany and Wordsworth and Coleridge in England. Wordsworth in his 'Prefaces' (1800-15) and Coleridge in his 'Biographia Literaria' (1816) discussed poetry as "the breath and finer spirit of all knowledge" and the imagination as a means of apprehending and revealing truth. (2) A disposition to revive and value the natural or popular poetry of the mediæval period, as exemplified by Percy's ‘Reliques of Ancient Poetry’ (1765) and the lectures and researches of Herder in Germany. (3) A corresponding disposition to discard and contemn the formal rules of poetic art which had been taught since the Renaissance and to exalt in their stead individual freedom and novelty of form. Representative documents in this connection are Victor Hugo's preface to ‘Cromwell’ (1827) and a famous passage in Macaulay's essay on ‘Byron’ (1831), ridiculing the classicist's idea of «correctness» in poetry.

Poetry of the 19th Century.— The romantic attitude continued, for the most part, to dominate the modern period, with emphasis on individuality, freedom, variety and intensity, as the qualities most highly valued in poetry; though this was tempered by the return, on the part of individual poets (like Goethe in Germany and Matthew Arnold in England), for guidance and inspiration to the poetry of the ancients. Extraordinary metrical variety, in contrast with the regularity and conservatism of the neo-classical schools, is characteristic of the whole of the past century. Another characteristic is the preponderance of the lyrical type, so marked that a distinguished critic has said that «the history of modern verse is mainly the history of lyrical sentiment.» That is to say, modern drama has been increasingly written in prose, modern epic has been developed but slightly, and narrative art has found its chief expression in the form of prose fiction. Perhaps the most characteristic poetic type of the 19th century is the dramatic monologue, which combines some of the elements of narrative with the subjective expressiveness of the lyric.

Recent Poetry.— The opening years of the 20th century have been marked by a revival of interest in poetry as a vital literary form and by a rich development of the spirit of experimentation. In particular, certain new movements or schools have arisen, analogous to similar phenomena in the arts of painting, sculpture and music; perhaps the most noteworthy calls itself by the name Imagism, a term brought into English from France. The qualities of this new poetry may be roughly described as consisting in (1) the attempt to represent freshly the fleeting impressions experienced by individual personality; (2) the rejection of all effort to interpret experiences generally or didactically; and (3) a preference for approximation and suggestiveness as distinguished from the attainment of finished form. The «new poetry» is especially marked by abundant metrical experimentation, often reaching the point of the abandonment of recognizable metre for rhythmic forms more eccentric or obscure than have yet been successfully analyzed. As in this respect there is a tendency to abolish the line between the art of verse and that of prose composition, so in the style or diction of recent poetry there is a disposition to avoid all distinction between the vocabulary and tone of the two kinds of discourse. This prosaic-poetic style was deliberately introduced into English poetry by Wordsworth at the end of the 18th century, was developed in different ways by such differently influential poets as Browning and Whitman and, in general, may be said to have gone far to do away with the older doctrine of a distinct vocabulary and style for poetry. On the other hand, it still remains doubtful whether the definite line between metrical and non-metrical composition can be blurred or neglected with lastingly pleasing results.

Bibilography.— For the general theory of poetry and the history of its forms, see Butcher's ‘Aristotle's Theory of Poetry and Fine Art,’ including a translation of the ‘Poetics’ of Aristotle (London 1898); Gayley and Scott's ‘Methods and Materials of Literary Criticism’ (Boston 1899); Alden's ‘Introduction to Poetry’ (New York 1909); Gummere's ‘Handbook of Poetics’ (Boston 1885); Gummere's ‘The Beginnings of Poetry’ (New York 1901); Cook's ‘The Art of Poetry; the poetical treatises of Horace, Vida and Boileau’ (Boston 1892); Leigh Hunt's ‘What is Poetry?’ edited by Cook (Boston 1893); Neilson's ‘Essentials of Poetry’ (Boston 1912); Alexander's ‘Poetry and the Individual’ (New York 1906); Coleridge's ‘Biographia Literaria and Æsthetical Essays,’ edited by Shawcross (Oxford 1907); Mill's essay, «Thoughts on Poetry and its Varieties,» in ‘Dissertations and Discussions’ (London 1876); Raymond, G. L., ‘Poetry as a Representative Art’ (New York 1885); Stedman's ‘The Nature and Elements of Poetry’ (Boston 1892); Combarieu's ‘Les Rapports de la Musique et de la Poésie’ (Paris 1894). For English poetic forms, see Omond's ‘Study of Metre’ (London 1903); Alden's ‘English Verse’ (New York 1903); Lewis's ‘Principles of English Verse’ (New York 1906); Saintsbury's ‘History of English Prosody’ (London 1910) and ‘Manual of English Prosody’ (London 1910); Andrew's ‘The Writing and Reading of Verse,’ (New York 1918)’.

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POETRY AND TRUTH. (‘Aus meinen Leben: Dichtung und Wahrheit’). Goethe's ‘Poetry and Truth’ is one of the great autobiographies of the world's literature. It is divided into four parts, the first three of which were written and published between 1811–14, while the fourth was written mainly in 1830–31 and published in 1833. Each part contains five books; in style, composition and interpretation of life, the fourth part is inferior to the other three. The whole treats only of the first 26 years of its author's life, but Goethe held that «the most important period of an individual is that of his development.» The material is distributed in such a way that Goethe's childhood is narrated from book one to the middle of book six; the account of his student-days begins with the latter half of the sixth book and continues through the 11th; books 12–15 are given to the consideration of his early manhood, when his first great successes as an author were realized. In spite of important experiences, part four does not open a new phase in Goethe's development, but it does bring the outer course of his life to its most decisive turning-point — his departure from Weimer. Goethe wrote ‘Poetry and Truth’ from the point of view of the scientist, the historian and the artist.

As a scientist he desired to picture his life as developing stage by stage «according to those laws which we observe in the metamorphosis of the plants.» As a historian he portrayed the general conditions of the times and revealed the relations between them and the individual. As an artist he did not feel tied down to facts for their own sake, but selects those that were of significance and moulded them so that they might become parts of a work of art. In the much-discussed title the word «Poetry» refers primarily to the artistic form of the work. One of the chief objects of Goethe's autobiography is to furnish a commentary for the understanding of his works. The leading topics of the different books are as follows: Book 1, Goethe's birth (1749), family and native city, Frankfort-on-the-Main; book 2, first inclinations toward poetry, fairy tale, 'The New Paris'; book 3, the French in Frankfort in consequence of the Seven Years' War, Count Thorane quartered with the Goethes; book 4, the boy's many-sided education, study of the Old Testament; book 5, youthful love, coronation of a German emperor in Frankfort. Book 6, Frankfort period concluded (1765), Goethe a student of law and literature at the University of Leipzig; book 7, German literature in the middle of the 18th century, fundamentals of Goethe's poetic talent; book 8, studies in art, return to Frankfort (1768), experiments in chemistry, religious convictions; book 9, Goethe a student of law and medicine in Strassburg (1770), German and French civilization, the cathedral, self-education and passion; book 10, mentor Herder, a trip through Alsace-Lorraine, love for Friedrike Brion of Sesenheim. Book 11, love-story continued, graduation as a student of law, alienation from French literature, admiration for Shakespeare, departure from Friedrike and from Alsace (1771); book 12, back in Frankfort, the Storm and Stress period, in Wetzlar, conditions leading to the conception of 'Goetz' and 'Werther'; book 13, trip from Wetzlar to Frankfort, comments on 'Werther' continued, publication and effect of both 'Goetz' and 'Werther'; book 14, Storm and Stress again, trip down the Rhine with Lavater and Basedow, influence of Spinoza, plan for a drama, 'Mahomet'; book 15, plans for an epic, 'The Wandering Jew' and a drama, 'Prometheus,' first meeting with the princes of Weimar, idea of settling permanently in Frankfort (winter 1774). Book 16, Spinoza again, poetry and profession, first meeting with Lili Schœnemann, Jung-Stilling; book 17, engagement with Lili, social and political conditions of the time; book 18, problems in prosody, journey to Switzerland as far as Saint Gothard; book 19, return to Frankfort, Lavater and his 'Physiognomy,' engagement with Lili broken, 'Egmont' begun; book 20, invitations from Weimar, the demonic influence in life, 'Egmont' continued, journey to Weimar (November 1775). Consult edition of Goethe's works in 'Deutsche National-Literatur' (Vols. XVII–XX. 1882–98); English translation by J. Oxenford, 'The Autobiography of Goethe,' «Truth and Poetry: From my own Life» (London 1846–48; new ed., rev., ib. 1881–84); Alt, C., 'Studien zur Entstehungsgeschichte von Goethes Dichtung und Wahrheit' (1898); Roethe, G., 'Dichtung und Wahrheit' (in *Berichte des Freien Deutschen Hochstiftes*, Jahrgang 1901, Frankfort am Main).

Ewald Eiserhardt.

POETS' CORNER, The, a popular name given a corner in Westminster Abbey in England, where there are memorials to many famous poets. Among those represented are Addison, Beaumont, S. Butler, Campbell, Cowley, Davenant, Drayton, Dryden, Gay, Goldsmith, Gray, Dr. Johnson, Ben Jonson, Longfellow, of America, Macaulay, Mason, Milton, Philips, Prior, Rowe, Shakespeare, Shadwell, Sheridan, Spenser and Thomson.

POEY, pō'āy, **Felipe,** Cuban naturalist: b. Havana, Cuba, 26 May 1802; d. there, 28 Jan. 1891. He was graduated in law from the University of Madrid, but abandoned his law practice and engaged in the study of natural history, later continuing his studies in Paris where in 1827 he aided in founding the Société Entomologique. He returned to Havana in 1833 where he made a study of Cuban fauna and in 1842 became professor of comparative anatomy and zoology at the University of Havana. In 1863 he was transferred to the chair of botany, mineralogy and geology. He published 'Memorias sobre la historia natural de la Isla de Cuba' (1860); 'Enumeratio Piscium Cubensium' (1875); 'Geografia de Cuba' (19 editions); etc. His most important work, 'Ictiologià Cubana,' was unpublished at the time of his death.

POGGIO BRACCIOLINI, pŏdj'ō brä-chō-lē'nē. See Bracciolini, Poggio.

POGROM, pō-grŏm, in Russia, an anti-Jewish riot. The first manifestations of these occurred in 1881 soon after the assassination of Alexander II. The Jews allege that the pogroms were the work of a secret society which operated with the connivance of the government officials. It were more true to say that the actions of Jewish money lenders in exacting their pound of flesh from the Russian peasant was the primary cause which soon involved all Jews indiscriminately. As the result of the persecutions of the 80's a great wave of Jewish emigration to America set in. In 1903 the pogroms were again instituted and in the following two years many Jews lost their lives. The greatest loss of life occurred at Kishinev, Bessarabia. A direct result was the emigration of hundreds of thousands of Jews to the United States and the British dominions beyond the seas.

POGY. See Menhaden.

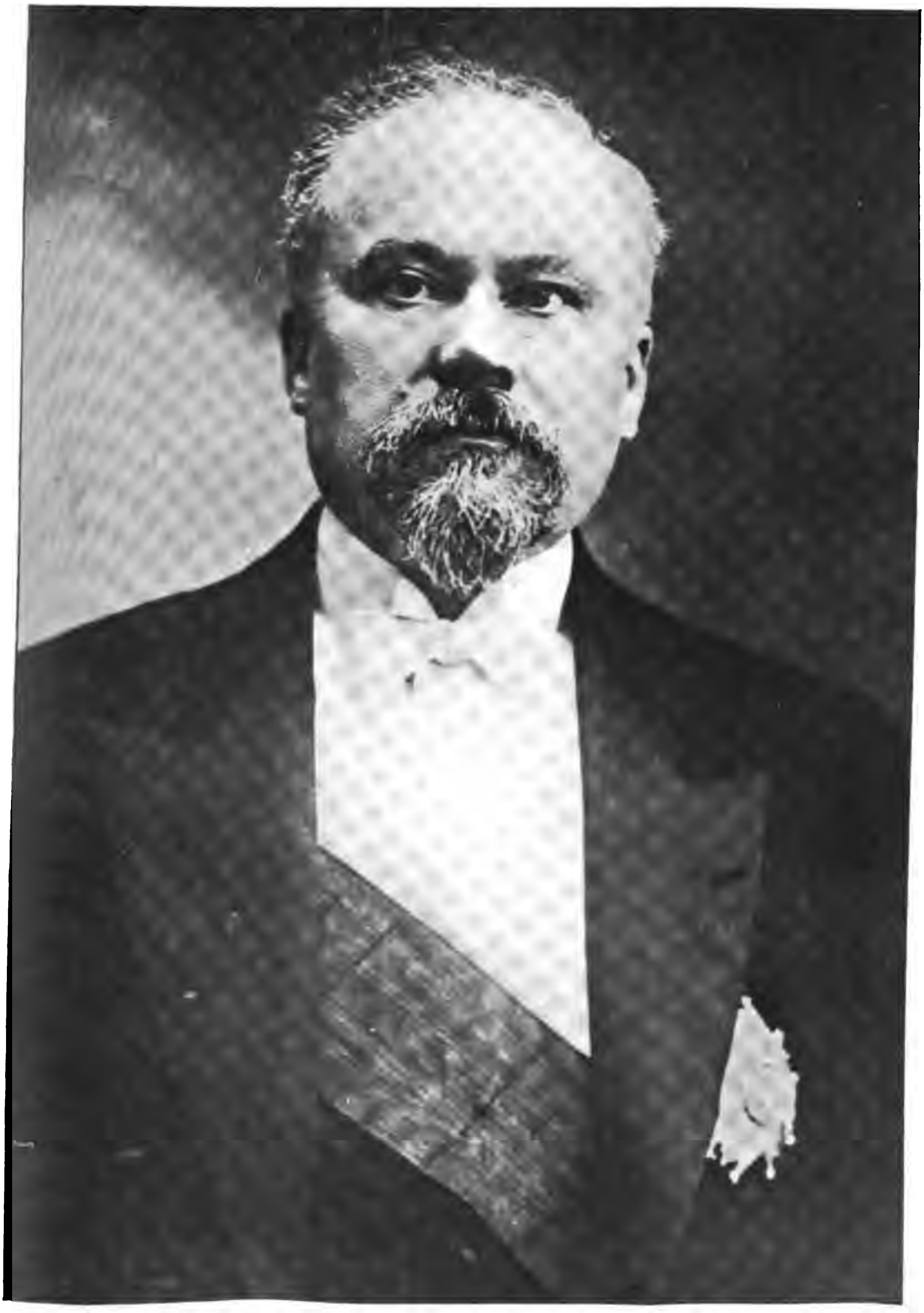
POI, a native food or porridge made from flour obtained by grinding the roots of tara or taro, a plant grown in most of the Polynesian islands, especially in Hawaii. The tops are used by the natives as pot herbs. The root is ground on stones by the native women and made into mush, which, among the Hawaiians of the lower classes, is eaten with the fingers out of a common dish.

POILU, pwä-lü' Fr. adj. «hairy,» from poil, hair, beard: popularly applied as a noun during the war to the French soldier in the field, as descriptive of his occasional unshaven appearance. This nickname appears to be now as firmly established as «Tommy Atkins» (q.v.) in the British army.

POINCARÉ, pwăṅ'ka̤'rā', **(Jules) Henri**, French mathematician and physicist: b. Nancy, 29 April 1854; d. Paris, 17 July 1912. He studied at the École Polytechnique in 1873 and two years later completed his work at the École Supérieur des Mines. In 1879 he received the degree of Doctor of Sciences and took up his residence at Paris, where he soon became prominent at the University. In 1886 he received the appointment of professor of mathematical physics and calculus of probabilities; and 10 years later succeeded Tisserand in the chair of celestial mechanics. The Académie des Sciences elected him to its membership in 1887 and the Académie Française in 1908. Poincaré received many prizes for his work, among which may be mentioned the Prix Poncelet (1885); the prize awarded by the king of Sweden for the solution of the problem of the three bodies (1889); the Prix Reynaud (1896); the medal of the Royal Astronomical Society (1900); the Sylvester medal of the Royal Society (1901); the gold medal of the Lobachevsky Fund (1904); the Prix Bolyai (1905), and the gold medal of the Association Française pour l'Avancement des Sciences (1909). Poincaré's principal contributions to mathematical science were along the lines of theory of functions. His researches in physics were likewise marked by profoundly scientific research. The Fuchsian functions were introduced into mathematics by him. Among his most important works are 'Leçons sur la théorie mathematique de la lumière' (2 vols., 1889–92); 'Electricité et optique' (2 vols., 1890–91); 'Thermodynamique' (1892); 'Leçons sur la théorie d'élasticité' (1892); 'Les methodes novelles de la méchanique céleste' (3 vols., 1892–99); 'Théorie des tourbillons' (1893); 'Les oscillations électriques' (1894); 'Capillarité' (1895); 'Théorie analytique de la propogation de la chaleur' (1895); 'Calcul des probabilités' (1896); 'Cinématique et mécanismes potentiels et mécanique des fluides' (1899); 'Théorie du potentiel Newtonien' (1899). Some of these smaller works are embodied in his comprehensive 'Cours de physique' (13 vols., 1890). A number of other works have appeared from time to time in the scientific journals of France, Germany and the United States. Consult Slosson, E. E., 'Major Prophets of To-Day' (Boston 1914).

POINCARÉ, Lucien (Antoine), French physicist, mathematician, brother of Raymond Poincaré (q.v.): b. Bar-le-Duc, Meuse, 1862. He was educated at the Lycée of Bar-le-Duc, the École Normale Supérieure and the University of Paris. Dr. Poincaré taught in various lycées between 1886 and 1893 and from 1894 to 1900 was professor at the École Normale of Sèvres, also holding a chair in the Faculté des Sciences of Paris in 1899–1900. He was appointed inspector-general of public instruction in 1902. His published works include 'La physique moderne, son évolution' (1906; English, as 'The New Physics and its Evolution' 1907); 'L'Electricité' (1907; English, 'Electricity, Present and Future,' 1908), and contributions to scientific journals.

POINCARÉ, Raymond, President of the French Republic: b. Bar-le-Duc, Meuse, 20 Aug. 1860. He was educated at the lycées of Bar-le-Duc and Louis-le-Grand and studied law in Paris. He practised for a short time and was a contributor to political journals. In 1886 young Poincaré was elected deputy and soon made his mark as an earnest student of government and legislation. He allied himself with the moderate Republicans, whose leader at that time was M. Méline. He did not take a prominent part in the Dreyfus case and opposed some of the policies of Waldeck-Rousseau. At the age of 33 Poincaré entered the cabinet as Minister of Public Instruction, which he relinquished the year following to take the portfolio of Finance. In the many cabinet changes which followed he held various portfolios, but he acquired especial distinction as Minister of Finance in dealing with the involved and difficult affairs of the budget. M. Poincaré became a Senator in 1903, but he appeared to be indifferent to advancement in the public service and for nine years gave most of his attention to his legal practice, reaching the front rank of his profession. In 1912 M. Poincaré became Prime Minister, taking charge also of the Ministry of Foreign Affairs. He supported warmly the alliance with Russia and furthered the entente cordiale with England. As an advocate of proportional representation he supported a bill on this matter in 1912, which passed the Chamber but was thrown out by the reactionary Senate. On 17 Jan. 1913 Raymond Poincaré was elected to the Presidency of the Republic, the ninth to hold that office. The new President soon let it be known that he intended to be no mere figurehead, with cabinet ministers directing the policies and wielding all the power. His election was particularly pleasing to Russia and to England because of his support of the entente and his advocacy of the new spirit of nationalism. The new President was soon the most influential person in his government and was fully cognizant of the Teutonic menace which had administered more than one humiliation to France since the beginning of the century. To checkmate it, the three-year military service law was passed despite the violent opposition of the Radical elements; the amiable relations with England and Russia were fostered, the President making visits to the capitals of those countries, where he was enthusiastically received. All his efforts, however, were unable to avert the catastrophe, which like an avalanche burst upon France in 1914. The five ensuing years of Poincaré's life are the history of France; his able voice urged on his countrymen to great deeds and despite the efforts of the Defeatists he kept the courage, enthusiasm and patriotism of his people keyed up to the highest pitch. He visited the soldiers in training camps, trench and hospital and to him no less than to his Premier, Clemenceau, is due in great part the successful outcome. M. Poincaré has found time to devote to literary subjects and is the author of several works, including 'Idées contemporaines' (1906); 'Questions et figures politiques' (1907); 'Causes littéraires et artistiques'; 'Ce que demande la cité' (1912; English translation, entitled 'How France is Governed,' 1913). Consult Dawbarn, Charles, 'Makers of New France' (New York 1915); Fullerton, W. M., 'Four French Statesmen' (Boston 1915); anon., 'Raymond Poincaré: A Sketch' (New York 1915).



RAYMOND POINCARÉ

President of the French Republic

POINCIANA, a genus of leguminous trees of the family *Cæsalpiniaceæ,* natives of tropical and subtropical regions. They are trees or shrubs, often with very showy scarlet, yellow, or orange flowers, called peacock flowers in some regions. One of the best-known species is the Bird-of-Paradise plant, *P. gilliesii,* a native of South America, but often cultivated in the warmer parts of North America.

POINDEXTER, poin'dĕks-tėr, **George,** American politician: b. Louisa County, Va., 1779; d. Jackson, Miss., 5 Sept. 1853. He studied law, practised in Milton, Va., and in 1802 established himself in Mississippi Territory where he was commissioned attorney-general in 1803. In 1806 he served in the territorial legislature, was a delegate to Congress in 1807–13, and in the latter year was appointed United States judge for Mississippi, an office which filled with much ability. His character was marred by his killing Abijah Hunt in a duel, in which he fired with undue promptness. He was the first representative of Mississippi in Congress after her admission to statehood in 1817, and in 1819 ably supported General Jackson's conduct of the Seminole War. He was twice elected governor of Mississippi, and in 1830 was chosen United States Senator, in which office he ceased to support General Jackson and was even suspected by the latter of complicity in the plot to murder him. In 1835 he removed to Kentucky, but subsequently returned to Mississippi, where he resumed his old political association.

POINDEXTER, Miles, American legislator: b. Memphis, Tenn., 22 April 1868. He was educated at Fancy Hill Academy and Washington and Lee University, and removed to Walla Walla, Wash., in 1891. In 1892 he was elected district attorney there, and in 1897 removed to Spokane, where from 1898 to 1904 he was assistant prosecuting attorney. From 1904 to 1908 Mr. Poindexter was judge of the Superior Court. He became a member of Congress in 1908 and soon identified himself with the Progressive wing of the Republican party. He was elected to the United States Senate for the term 1911–17 and re-elected for the term 1917–23. Senator Poindexter supported Roosevelt and the Progressives in 1912.

POINSETT, Joel Roberts, American diplomat: b. Charleston, S. C., 2 March 1779; d. Statesburg, S. C., 12 Dec. 1851. He completed his education at the University of Edinburgh and at Woolwich Military Academy, England, and in 1809 was United States commissioner to South America to investigate political conditions prevailing there. While in Chile he obtained the release of American merchantmen who had been seized by the Spanish authorities of Peru on a rumor of the declaration of war with the United States. He was elected to the South Carolina legislature on his return and in 1821–25 was a member of Congress; he served in 1825–29 as minister to Mexico and afterward allied himself with the «Union» party in strenuous opposition to the nullification issues. He was Secretary of War in 1837–41, and in 1840 was instrumental in the passage of the bill to reorganize the militia. The last years of his life were spent in retirement; he founded an academy of fine arts in Charleston, and published 'Notes on Mexico, Made in 1822; with an Historical Sketch of the Revolution' (1824).

POINSETTIA, a shrub (*Poinsettia pulcherrima*) of the family *Euphorbiaceæ.* It is a native of shady and damp tropical and subtropical Central America and Mexico, whence it was introduced into cultivation by Dr. Poinsett of Charleston, S. C., and distributed by Robert Buist of Philadelphia. The plant grows six feet or more high, bears small, yellow terminal flowers surrounded by brilliant vermilion bracts, for which the plant has become famous as a greenhouse subject. These bracts, in well grown specimens, are often nine inches long. They are sometimes cut for decorative purposes, but usually the plants are left in pots. In mild climates, such as Bermuda, southern Flordia and California, the plants are grown out of doors, but they never reach perfection, and must generally be grouped with other plants to conceal their bare, crooked stems.

POINT, that which has no part, but merely position. There are various definitions all to a degree unsatisfactory and defective because of the elemental nature of the term. Consult Heath, T. L., 'The Thirteen Books of Euclid's Elements' (Vol. I, New York 1908).

POINT BARROW, a cape of Alaska in lat. 71° 25′ north and long. 156° 25′ west, the most northerly cape of the Alaskan peninsula and the most northerly inhabited part of North America. There are a post office, Eskimo school, and a resident physician and a population of about 200. It is an important base for whale fishers.

POINT-DE-GALLE, point dė găl, or **GALLE,** Ceylon, a fortified seaport town on a peninsula on the south coast, 21 miles west of Matura, and 66 miles south-southeast of Colombo. The appearance of Galle from the sea is singularly beautiful and picturesque. To the right is the fort, further on is the quay, surrounded by multitudes of canoes, while close to the harbor is the native town, white and shaded by numerous trees. Outside the town is a Buddhist temple. The trade of Galle consists chiefly in coir rope, cocoanut oil, arrack, chaya root, coffee, cotton, rice, ivory, cinnamon and tortoise-shell. It was under Dutch control from 1642 to 1796, when it was acquired by Great Britain. Pop. (1911) 39,960.

POINT-LACE. See LACE.

POINT PLEASANT, Battle of, fought 10 Oct. 1774, in what is now West Virginia. The action took place at the mouth of the Great Kanawha River; on one side were some 1,200 Virginians commanded by Andrew Lewis (q.v.); on the other a force of Indians numbering about 1,000, led by Cornstalk (q.v.), the Shawnee chief. The battle lasted throughout the day and was fought with desperation on both sides, Indian tactics being adopted by the whites, who finally gained the victory. Both sides lost heavily, the whites 75 killed and 150 wounded, among the killed being Col. Charles Lewis. The Indian loss has never been definitely ascertained but is believed to have been quite as great as that of the men under Lewis. By a treaty following the battle the Indians gave up to the whites an extensive tract south of the Ohio River. The battle proved to be of much importance in connection with the Revolutionary developments in that part of the country, and its results had much to do with opening Kentucky to the whites. See COLONIAL WARS IN AMERICA, *Lord Dunsmore's War*.

POINTE-Á-PITRE, pwänt-ä-pētr, Guadeloupe, West Indies, the largest and richest town in the island of Grande Terre, the smaller of the two composing Gaudeloupe, with a good harbor at the mouth of the Rivière Salée, which separates Grande Terre and Basse Terre (see GUADELOUPE). The city was built in 1763, was destroyed by earthquake, 8 Feb. 1843, and suffered from fires in 1871. Once a great port, it still carries on some business, exporting sugar, cocoa, hides, coffee, rum, molasses, etc. Pop. 22,664.

POINTED ARCHITECTURE, a name for the Gothic styles. See ARCHITECTURE.

POINTER, a race of bird-hunting dogs, allied to the setters but smooth-haired. See DOG.

POINTERS, The, *in astronomy*, two stars, Merak and Dubhe, in Ursa Major, so called because they point to the pole star.

POINTILLISM, the division of tones in painting by very small dots of equal size, causing the spherical shape to act equally upon the retina of the beholder's eye. The accumulation of these luminous points is carried out over the entire surface of the canvas. The theory of complementary colors is systematically applied (see IMPRESSIONISM). Pointillism is an offshoot of impressionism, a movement that coincided with certain scientific research concerning optics: Helmholtz had published his works on the perception of colors and sounds by means of waves; Chevreul had established his beautiful theories on the analysis of the solar spectrum; and Charles Heary, an original thinker, had applied these new principles to æsthetics and had the idea of establishing relations between optics and the laws of painting. These researches found fruit in the work of the younger painters of the impressionist school, who thought of carrying its chromatic principles still further. These painters, working from about 1880 to 1889, endeavored to establish some laws concerning the reaction of tones — and particularly those concerning complementary colors — in such a manner as to be able to draw up a kind of table or system. Georges Seurat and Paul Signac were the promoters of this research; and to these two painters is due the method of Pointillism. The works of Seurat, Signac and other artists who have strictly followed the rules of Pointillism are somewhat lacking in life, spontaneity, caprice and charm; for the dryness and mathematical quality of the style (which reduces a picture to a kind of theorem excluding all that gives charm to a work of art) afford scant opportunity for the display of individual temperament. Besides Seurat and Signac other French painters of this so-called Neo-Impressionist School are Maurice Denis, Henri Edmund Cross, Angrand and Camille Pissaro (1831–1903). The Belgian, Théo Van Rysselberghe, is also an exponent of the Pointillist method. There are also a number of painters in the United States who work in this style. The Neo-Impressionists, like the Impressionists, are chiefly occupied with the problems of light, following the instruction laid down by Manet: "The principal person in a picture is the light."

POIRÉ, pwā-rā, **Emmanuel**, French caricaturist, known also by his signature CARAN D'ACHE: b. Moscow, Russia, 1858; d. 26 Feb. 1909. He first gained considerable reputation in France by drawings in various Parisian journals. He made particular study of military types, and especially came to depict French cavalry with great facility and truth. His work was collected into albums that called 'Psst!' (1898) containing drawings evoked by the Dreyfus case. His signature is an adaptation of the Russian word for "pencil."

POIRIER, pwä'ryä', **Pascal**, Canadian legislator: b. Shediac, New Brunswick, 1852. He received his education at Saint Joseph's College, Memramcook; was called to the Quebec bar in 1877 and to the bar of his native New Brunswick. Mr. Poirier became a dominion senator in 1885, sitting with the Conservatives. He was the leader of the so-called "Acadians," those who professed descent from the French colonists of Nova Scotia, who were expelled in 1755. He has published 'L'Origine des Acadiens' (1887); 'Le Père Lefèbvre et l'Acadie' (1891); 'Des Acadiens deportés à Boston en 1775' (1909); 'History of the Maritime Provinces from the Acadian Point of View' (1914), narrow and bigoted and worthless as an historical record.

POISON ALDER, or SUMAC. See PLANTS, POISONOUS.

POISON GAS. In the four years' World War (1914–18), gas was first used in 1915, by the Germans as a means of attack against the French and Canadian troops, who were holding positions on the Ypres salient. It came as a complete surprise to the Allies who retaliated and later employed poison gas as a weapon, using two methods of attack, commonly known as the gas cloud or mist attack and the gas shell attack. In the gas cloud attack the gases or asphyxiants used are chiefly chlorine and phosgene, which act through the lungs, causing death by suffocation. These gases are heavy, easily turned into liquids and are very poisonous. They are liquified by cold and pressure and placed in metal cylinders, weighing over 100 pounds. The cylinders are taken up to the front line trenches and placed in special emplacements under the fire step. When the wind is favorable for an attack the gas is liberated by turning the stop-cock of the cylinders. The gas being heavy, is carried by the wind, close to the ground, towards the troops to be attacked, remaining in the bottom of the trenches, dugouts, etc., for several days if not removed. In the *gas shell* attack all areas within five miles of the front line are liable to be attacked. These shells are fired from heavy and light howitzers and trench mortars (Minenwerfer). The greater part of the explosive is removed and replaced by a poisonous liquid, which when the shell bursts, turns into a heavy vapor that hangs about the position for a long time. When fired alone, the shells can be detected by the *wobbly* motion made coming through the air, by the slight noise made on bursting and by the appearance of a whitish cloud when the shell bursts.

Gas shells contain a small bursting charge and a liquid chemical substance which is converted into vapor and gas when the shell bursts. To insure satisfactory effects a large number must be discharged in a small space. The bursting charge, though less powerful than that of the ordinary shell, is nevertheless sufficient to produce a considerable explosive effect in addition to the actual gases. Protection of dugouts, cellars, buildings, etc., is given by well-fitting doors or by blankets sprayed with hyposolution from a Vermorel sprayer. Practically no gas passes through a wet blanket, and the protection depends on getting a good joint at the sides and bottom of a doorway, so as to stop all draughts. This can be effected by permitting the blanket to rest on battens, arranged with a slight slope, against the door frame. The blanket should overlap the outer sides and a fold should lie on the ground at the bottom. The protection afforded by these means is as complete against lachrymatory gases as it is against cloud gas and poisonous shell gases. Chlorine is greenish yellow in color, is two and one-half times heavier than air, and hence rolls along the ground. Phosgene is colorless and is three and one-half times heavier than air. It acts as an asphyxiant, but is only half as strong as chlorine. It has a delayed action on the heart, which acts two days afterward, and hence in trenches after an attack troops and horses are rested for 24 hours, inasmuch as any exertion after being gassed by phosgene makes the effects much worse. It requires from three to six hours to clean away chlorine and phosgene by natural ventilation.

Carbon monoxide, gas shells and mustard gas (q.v.) are most commonly used in gas warfare. Carbon monoxide is not used directly in attacks, but causes many casualties. It attacks the blood corpuscles and they no longer carry oxygen, and being lighter than air it cannot be used as a cloud gas. It cannot be easily liquified and hence is not suitable for gas shells. Respirators do not protect against this gas. As a protection from this gas Salvus sets are issued to machine gunners and batteries. These sets consist of cylinders of oxygen opening into bags of waterproof material from which issue tubes leading to mouthpieces and cut off the men entirely from the outside air. Gas shells are ordinary shells from which the greater part of explosive has been taken and replaced by a poisonous liquid, which, when the shell bursts, turns into a poisonous gas or vapor, and being heavy, remains about the place where the shell bursts. Only enough explosive is used to burst the shell and set the gas free. Gas shells are usually divided into four main divisions — asphyxiants, paralysants, lachrymatory and mustard gas, according to chemicals inside. The mustard gas shell contains heavy liquid which does not evaporate easily and affects the skin, forming ulcers, sores, etc. This gas causes a loss of the sense of smell for other gases temporarily.

There are various methods of gas attacks — such as emanation, cloud or mist, and chemical shells. Emanation is the least important method and consists of scattering chemicals about trenches which are to be deserted. This chemical when brought in contact with moisture or stirred up by the digging of occuying troops produces a poisonous gas. The cloud or mist method consists of bringing gas up to the front line in cylinders or tanks under heavy pressure and releasing it when the wind is in a favorable direction for carrying it over enemy trenches. On a clear dry day the gas rolls along close to the ground as a faint green mist gradually growing thinner and less deadly as it advances and dissipates. On a damp day the gas, which has a strong affinity for moisture, appears as a greenish yellow cloud bank and is often harmless at as much as 200 yards. Chemical shells are dangerous because there is no warning. This method is used against the artillery which usually is too far back to be affected by cloud attacks except under very favorable circumstances. The average shell contains about five pounds of gas in liquid form which expands when released by the explosive charge in about the same ratio as water to steam. A heavy and concentrated attack with these shells produces the same effect as a cloud attack, but with the added element of surprise. Methyl sulphate and pelite are among the most poisonous gases used in shells.

The bromacetone and xylylbromide (used mostly in German shells) are classed as lachrymal gases because they directly affect the lachrymal or tear glands of the eye causing a large secretion of tears and smarting of the eve which temporarily blinds the enemy. The effect of chlorine and bromine depend on the amount of gas in the atmosphere. Both kill by suffrocation when in sufficient quantities. One part of chlorine to one thousand parts of air will cause paralysis of the glottis and men will tear their throats open with their fingers in their efforts to get air. Bromine effects are identical, but more violent. Phosgene gives a different effect, but the final result is the same. Men attacked by phosgene feel no serious effects for hours, when thev suddenly sink into a fatal collapse with all the symptoms of heart failure. The anhydrides, when they come in contact with the moisture of the lungs, like phosgene, form acids corresponding to their bases, with similar effects. The effects of prussic acid gas are entirely different from the other gases. It acts directly on the nervous system, in dilute form produces dizziness, headache, pains in the chest and difficult breathing, coma and sometimes convulsions preceding the end.

The accepted methods of defense against poisonous gases are the gas mask or helmet and the respirator. Those are of various kinds, but may be divided into two types — the P. H. helmet and the Box respirator. The P. H. helmet consists of a double flannelette bag with two eyepieces and a mouthpiece through which the breath can be exhaled, but which collapses if it is attempted to inhale through it. The flannelette is impregnated with solutions of carbolic acid and phenol, caustic soda, hexamine and glycerine. The carbolic acid and phenol constitute the neutralizing agent for the chlorine gas. The caustic soda is a protection against prussic acid and hexamine takes out the phosgene. Signal stations, command posts, dressing stations and dugouts for troops in the support line when in the zone of gas attacks are generally provided with blanket curtains impregnated with these chemicals. The box respirator consists of a small canvas haversack (called a satchel), of two compartments, one of which contains the metal filter with its charge of chemicals; the other (the mask), called the facepiece, is made of rubberized material with mica eyepieces, a nose clip, a rubber mouthpiece shaped to be gripped in the teeth and terminating on the outside in a flat rubber valve similar to that on the P. H. helmet. The mask fits the face closely and is held in place by broad elastic bands passing around the head.

The anti-gas horse respirator consists of a flannelette bag with a canvas mouthpiece which goes into the horses mouth and saves the flannelette from being bitten through. The bag is provided with an elastic band which passes round the opening so as to draw the respirator close to the face when in use. Inside the bag and attached to the canvas mouthpiece there is a canvas frame which is stitched on to the bag in such a way as to prevent the material being drawn into the nostrils when the respirator is in use. The whole is folded and carried in a canvas case provided with a flap. Horses can stand a higher concentration of gas than human beings without serious damage and hence it is not necessary to protect them against cloud gas attacks when they are a great distance behind the trenches. Nor is it necessary to protect their eyes. The respirator is primarily intended for use on transport animals when they are sent to the trenches with supplies, ammunition, etc. When not required for immediate use the respirator can be conveniently carried on the supporting strap of the breast harness, or if a zinc wither pad is worn, still more conveniently inside this pad. However carried, the case is steadied by being strapped on either side to the metal ring on the supporting strap, and its flap should be passed under this strap, between it and the numnah wither pad, and buttoned as in the *alert* position. Poisonous gases have been used in warfare with the intention of forcing men out of action, hampering artillery, preventing supports from advancing, and inspiring terror, so that an advance may be made with a slight opposition and some military advantage secured. Apart from a question of an advance, poisonous gases have been used merely as a means of causing casualties on the opposing side and of inspiring general terror.

Rest is the most important point of all in the general treatment of gas casualties. Men, and especially officers, should be warned beforehand that if lightly gassed they must refrain from moving about or calling out orders. Physical strain after gassing may involve the loss of a life that might otherwise have been restored in a brief time. The principle of attaining complete rest as soon as possible underlies the detailed advice for dealing with gas casualties, and is the reason for their detention at the casualty clearing stations. Arrangements should be planned beforehand at each casualty clearing station so that even a large number of gas casualties can be handled with discipline and control. Next in importance to rest comes the use of oxygen, protection from cold, special stimulants or drugs, venesection and methods for removing serous exudate from the lungs. Oxygen, if slightly administered, will generally lessen cyanosis, but the lung surface available for absorption is so small that the oxygen must be given in high concentration. Venesection gives real relief to men with deep cyanosis and a full pulse, but appears to be harmful in collapsed cases with poor pulses, and it should not be postponed until the patient passes into the dangerous state. Gas casualties, who show neurasthenic or cardio-vascular weakness after several weeks' treatment at the depot should be transferred to home hospitals.

Edward S. Farrow,
Consulting Military and Civil Engineer.

POISON IVY, or **POISON OAK,** the *Rhus Toxicodendron,* of the natual order *Anacardiaceæ,* a climbing plant with pinnately compound leaves. Its autumn coloring is very attractive, but its touch affects certain constitutions disastrously; even in a dry state it contains an oil, which soon after touching the skin, creates redness and violent itching, followed by fever and a vesicular eruption. The poison is most virulent when the plants are blooming. Immediate washing after contact with the plant will sometimes prevent the trouble and very hot soapsuds, or a solution of sugar of lead will alleviate the suffering. See Plants, Poisonous.

POISON-NUT, a name for *Strychnos nux vomica.* See Nux Vomica.

POISON OF SERPENTS. See Serpent: Rattlesnake, etc.

POISON SPRINGS (Ark.), Engagement at. On 17 April 1864 a train of 198 wagons left Camden, Ark., and went westward 18 miles on the Washington road to collect forage and other supplies. It was guarded by 195 cavalry, 500 infantry and two guns, under command of Colonel James M. Williams, 1st Kansas Colored Volunteers. Next morning Williams was reinforced by cavalry, infantry and two guns, raising his force to 285 cavalry, 875 infantry and four guns. A greater part of the wagons had been loaded on the 17th, and on the morning of the 18th Williams started on his return to Camden, gathering forage on the way, and when about 12 miles from that place was intercepted by Marmaduke's cavalry. General Maxey soon joined Marmaduke, the united commands of about 3,200 men and four guns attacked Williams, and, in a four hours' fight, routed him, capturing about 100 prisoners, his four guns and the entire wagon-train. The Union loss was 92 killed, 97 wounded and 106 missing. Incomplete Confederate returns make their loss 17 killed, 88 wounded and 10 missing; their entire loss was about 155. Consult 'Official Records' (Vol. XXXIV).

POISONS AND POISONING. See Toxicology.

POISSON, pwä-sôṅ, **Siméon Denis,** French mathematician: b. Pithiviers, France, 21 June 1781; d. Paris 25 April 1840. He was educated in the Ecole Polytechnique, Paris, and occupied positions as examiner and professor in that institution for nearly 40 years. He was a member of the Bureau des Longitudes, professor of mechanics on the Faculty of Sciences at Paris, was appointed a member of the council of the university in 1820, and in 1837 made a peer by Louis Philippe. He wote over 300 scientific papers and other works of great value, covering mathematics, physics, and astronomy, the most famous of his works being 'Traité de Mécanique' (1811). Among other works are: 'Théorie Mathématique de la Chaleur' (1835); 'Recherches sur la Probabilité des

Jugements en Matière Criminelle et en Matière Civile' (1837).

POISSON'S RATIO. See Elasticity.

POISSY, pwä-sē, France, a town in the department of Seine-et-Oise, on the left bank of the Seine, 11 miles southwest of Versailles. The weekly cattle market, chiefly for the supply of the capital, is said to be the largest in France. The town possesses considerable historical interest from the famous conferences of Poissy in 1561, in which the differences between Roman Catholicism and Protestantism were discussed at great length, but with no decisive result. Among the attendants were Charles X and Catherine de' Medici; the principal debaters were Theodore Beza and the papal legate Ippolito d'Este. It is also noted for its attractive church dating from the 12th century. Pop. prior to the world war about 6,000.

POITIERS, pwä-tē-ā (formerly spelled Poictiers), France, the former capital of the province of Poitou, at present of the department of Vienne, 61 miles southwest of Tours. It stands mainly on an eminence at the junction of the Clain with the Boivre, and retains its old walls and towers. The principal edifice is the cathedral, founded by Henry II of England about 1162 and built in a style exhibiting the transition from Romanesque to the Gothic. Other ecclesiastical buildings include the ancient church of Saint John, originally a baptistery; and the church of Saint Radegunda, the patroness of the town, with a crypt containing her tomb. The modern town-hall, the law-courts, occupying the palace of the former counts of Poitou, the museum, the library and university building, also deserve notice. There are some interesting Roman and early Gallic remains. The manufactures are not of much importance. Poitiers is historically celebrated for the battles fought in its vicinity between Poitiers and Tours, when Charles Martel defeated the Saracen army 18 Oct. 732, and when the French under their king John II were defeated by the English under Edward the Black Prince 19 Sept. 1356. It is one of the oldest towns in France and occupies the site of Lemonuen, the chief town of the Pictones, mentioned by Julius Cæsar («Bell. Gall.» iii, 11; vii, 75; viii, 26). Its neighborhood has been the field of three of the greatest and most decisive battles ever fought in France prior to the world war, the first resulting in the defeat of the Visigoths under Alaric A.D. 507 by Cloirs and his Franks. Pop. (1911) 41.242.

POITOU, pwa-too, or **POICTOU,** France, a former western province now comprised in the departments of Vienne, Deux-Sèvres, and Vendée. This district was anciently inhabited by the Gallic Pictavi, from whose name that of Poitou is derived. Henry II of England acquired possession of Poitou by his marriage with Eleanor, heiress of the last Duke of Aquitaine. Philip Augustus conquered it in 1204. It was ceded to the English by the Peace of Bretigny (1360), but was recovered by Charles V. Its early history is identical with that of Aquitania. See France, *History*

POKANOKET, the name of a tribe of North American Indians. See Wampanoag.

POKER, or **DRAW-POKER,** a card game said to have originated in the United States, and of which there are several varieties, the most common being draw-poker, played with a pack of 52 cards and any number of players. The game begins by the dealer staking a sum agreed on, called the ante, after which he deals five cards to each person. Each then successively looks at his cards, beginning on the left of the dealer, and according to their value he may either throw up his hand or play, in the latter case putting double the ante into the pool. The dealer who looks at his hand last may in like manner either «go out of the game,» or «make good» his ante by adding enough to double it. The dealer then asks those who are to play if they wish to «fill their hands,» that is, receive one or more cards from the pack in exchange for others discarded, or if they will play their original hand. When this is arranged the players, beginning with the one on the left of the dealer, have the «say» as to whether they will now go out of the game and lose their stakes or «raise,» that is, add a sum to that already staked. When any one agrees to raise, the next in succession must declare whether he is to go out of the game; «see the raise,» that is, add an amount equal to that just added by the previous player; or «go better,» that is, add more than an equivalent. This goes on till either all are out but one, who accordingly takes the stakes, or several are left in who all «have seen the raise» but not «gone better.» In this latter case the hands have to be shown, and the holder of the best hand takes the pool. The most valuable hand is when a player has a sequence of five cards of the same suit, called a «straight flush», the absolutely best hand being the sequence of ace, king, queen, knave, ten. The hands next after a straight flush in descending value are: «fours,» or four cards of the same rank and another card; a «full,» or three cards of the same rank with other two forming a pair; a «flush,» that is, five cards of the same suit not in sequence; a «straight,» or sequence of five cards of more than one suit; «triplets,» three cards of the same rank and other two not forming a pair; two pairs; one pair, with other three cards of different ranks; lastly, the highest card. The cards rank in value as at whist, except that the ace may be the highest or lowest card in a straight. Consult Foster, R. F., 'Practical Poker' (1904); D'Allemagne, 'Les cartes à jouer' (Paris (1906); and Jessel, 'Bibliography of Works in English on Playing Cards and Gambling' (London 1905).

POKEWEED, POKEBERRY, POKEROOT, or **POCAN,** a strong-smelling perennial herb (*Phytolacca americana* of the family *Phytolaccaceæ*. It is a native of the United States from Maine to Florida and westward to Minnesota and Texas. It is 3 to 12 feet high, bears smooth, entire leaves, and long racemes of small flowers followed by dark purple berries which ripen in late summer and autumn. The young shoots and the seedlings are often eaten; the former like asparagus, the latter like spinach; the berries are a favorite food of birds, especially robins, whose flesh is often tinted by the deep crimson juice, which is used for coloring and adulterating wines. Its name is said to be derived from the Indian *pocon*, a dye-yielding plant; for example, blood-root. Other popular names are garget, pigeonberry, inkberry and scoke. The dried roots and a fluid extract have been used in medicine for reducing corpulency, but they seem to be losing in favor. In Europe the plant has become naturalized and there, as at home, is sometimes a troublesome weed. Two Asiatic species, *P. esculenta* and *P. acinosa*, as well as the above species are occasionally cultivated for their young shoots and foliage.

POLA, pō'lā, a maritime town in the peninsula of Istria, on the Adriatic Sea, 55 miles south of Trieste. It is a fortified town of the first rank, and formerly the chief station of the Austro-Hungarian navy. It was once a place of importance; but it had sunk to the level of a mere fishing village when the Austrian government (1855) selected it as their chief naval station and by the construction of dockyards, an arsenal, barracks and other government establishments infused new life into it. The entrance to the harbor is narrow, but the water is deep, and with it expands into a basin, landlocked and safe, and large enough to accommodate the largest fleet. Forts and batteries on hills forming the background protect the harbor. Among the ancient remains are the ruins of an amphitheatre, estimated to have been large enough to accommodate 18,000 persons; there are also two temples, one of which is in good preservation. Pola was most flourishing in the reign of Severus, when it is said to have had a population of 30,000, and was a station of the Roman fleet. A triumphal arch, erected by Salvia Posthuma in honor of her husband Sergius Lepidus, is in a good condition, and under the name of Porta Aurea is used as a gate of the town. The principal modern edifice is the cathedral, which dates from the 9th century. The population, which has more than doubled since 1880, was 70,145 in 1910.

POLACCA, or **POLACRE**, a small sailing vessel common in the Mediterranean. The masts are usually three in number, and consist of only one spar, so that they have neither tops nor cross-trees. They are usually rigged with square sails.

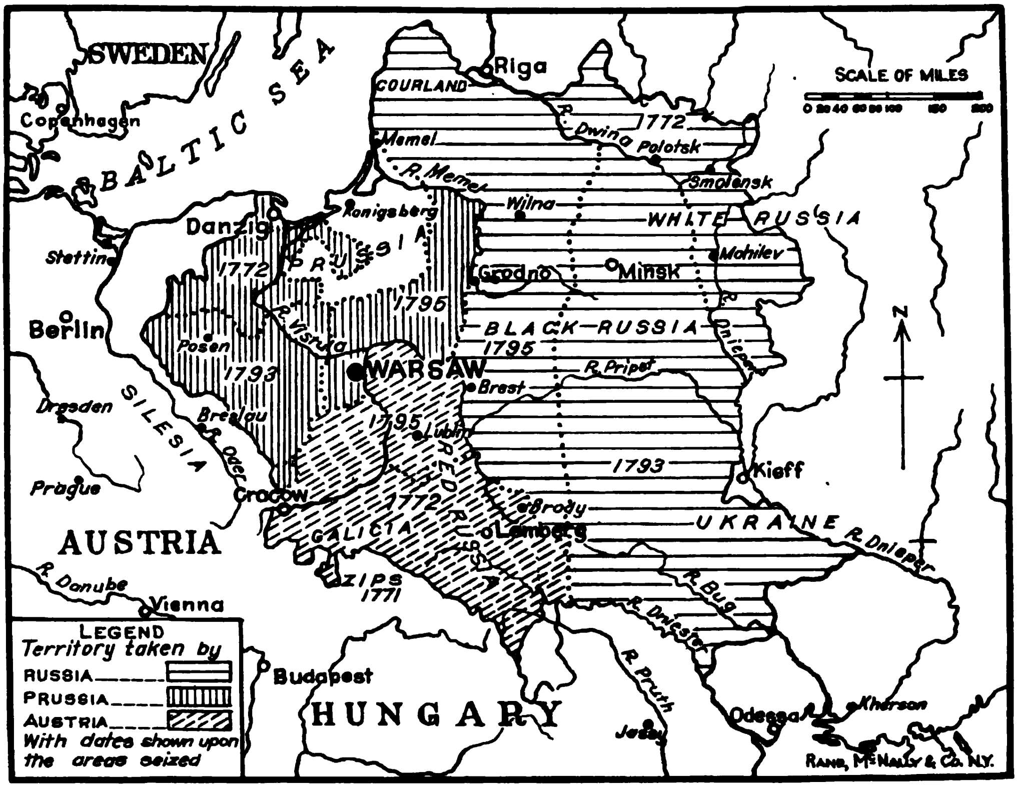
POLAND, pō'land, **John Scroggs**, American military officer: b. Princeton, Ind., 14 Oct. 1836; d. Asheville, N. C., 8 Aug. 1898. He was graduated from West Point in 1861, served in the Army of the Potomac until 1863, participated in the battles of Antietam, Fredricksburg and Chancellorsville, and from 1863 to 1865 was commissary of musters for the Department of Washington. He was brevetted lieutenant-colonel for gallantry at Chancellorsville and was assistant professor at West Point 1865–69. He then engaged in frontier duty and in 1881–86 was chief of the department of law at the United States Infantry and Calvary School at Fort Leavenworth, Kan. In 1898 he was commissioned brigadier-general of volunteers and died while in command of the 2d Division of the First Army Corps at Chickamauga. He wrote: 'Digest of the Military Laws of the United States from 1861–1868' (1868); 'Saint Petersburg International Commission' (1886), etc.

POLAND, a republic of considerable size in eastern Europe, bounded on the west by the Oder and Warthe rivers, in the east by the Dnieper river, on the south by the Carpathian mountain range and the Dniester River, and in the north by the Dwina River, and its tributaries, and the Baltic Sea. At this writing the exact frontiers of new Poland, and hence its precise size are still in doubt, but approximately the country will contain some 250,000 square miles, with a population of, roundly, 26,000,000. The chief navigable river of this newly created Poland is, as was that of old Poland, the Vistula, and its main outlet on the sea is the splendid harbor of Danzig, on the Baltic. Ethnologically considered the population of Poland is made up of six chief elements, these being Poles proper, Ruthenians, Lithuanians, White Russians, Jews and Germans. The Poles are a branch of the ancient Lekhs who dwelt on the borders of the Vistula as early as the 6th century, having settled there during that long Slavic migration when Slavs of every kind spread as far south as the Balkans and north as far as the Urals. There are indications that the forebears of the Poles, forming part of this great movement, were driven out by the Romans during the 3d and 4th centuries from their abodes along the Danube in Pannonia (now Hungary). Ethnically the Poles belong to the western Slav group, but they have undergone a thorough mingling and mixing process, both in historic and prehistoric times, and bear unmistakable marks of their multiform descent. They are slightly below the medium height, mostly blond, and of lengthened skull, with fair skin. In actual numbers the Polish race is not easy to compute, but the nearest available approach to accuracy puts their number at about 15,000,000, viz.: In former Russian territory (census of 1912, being the most recent extant) 5,832,000 in «Russian Poland,» and 1,594,000 in the nine western provinces (or «governments») of Russia, together, 7,426,000; in Austria-Hungary, more specifically in Galicia, 3,171,400; and in Germany, 3,305,749 — a total of 13,903,149; to which 1,707,640 must be added in the United States, and other countries. The Ruthenians (Russniaks, Ukrainians) form a branch of the «Little Russians,» the purest Slavic type in existence, much less affected by Mongolian admixture than the Russians proper. This branch of the great Ukrainian groups of Slavs which has been under Polish domination for many centuries numbers about 4,500,000 all told, nearly altogether settled in Eastern Galicia. They are of medium height, rather slender, swarthy, with dark hair and brown eyes. Their tongue is simpler in construction and more euphonious than Russian proper. The bulk of them belong to the Uniate Greek Catholic faith, acknowledging, within certain limits, Papal authority. The alphabet in use with them, however, is the Cyrillian, as with the Russians, and their priests must be married men. The Poles themselves are, quite overwhelmingly, devout Roman Catholics. Owing to their essentially pacific character and to the state of poverty and subjection in which they have been held by their Polish overlords, culturally the Ruthenians are decidedly inferior to the Poles. The Lithuanians, who number some 2,000,000 on formerly Russian soil and about 100,000 in a certain part of East Prussia, are a branch of the Letto-Lithuanian group, standing ethnically about midway between the White Russians and the Baltic races. They dwelt mainly in the former Russian provinces of Kovno, Grodno, Vilna and Suwalki. Their idiom approximates old Sanskrit more closely than does any other European tongue, as in *sukù*, I turn; *dvēsmi*, I hate; *rankà*, hand, etc., and there is absolutely no similarity with Polish. Bodily the Lithuanians are well-made, blond, of blue eyes, oval face, fair skin, and of medium height. The Letts are their closest of kin. Intellectually they are of fair ability. Their folklore and fairy tales are derived from vast antiquity and are quite distinct. The White Russians are the descendants of the ancient Slav tribes, the Dregovitchi and Krivitchi, and for centuries they formed a part of Lithuania, where, in fact, White Russian speech was used as the official language for a long space. Strictly speaking, White Russian is not a dialect of Russian proper but rather a form of Slavic independently developed, though most closely related to Great Russian. Those territories of White Russia now devolving to Poland number about 1,000,000 of White Russians among the population as a whole. The Jewish strain among the population of Poland is estimated at another 2,000,000, or slightly more or less, and belongs to the Eastern division of the Hebrew race. A large proportion of them are derived from those Jewish fugitives from Germany during the early Middle Ages who fled from religious persecution and took the German idiom of those days with them to their new home on Polish soil, whence the Yiddish of to-day. In all the German element forming part of the recreated Poland of to-day numbers between three and four millions, but not all of it is purely German in race, some intermingling of Poles and Germans having gone on in the districts in question, especially since Polish territory had been appropriated by Prussia.

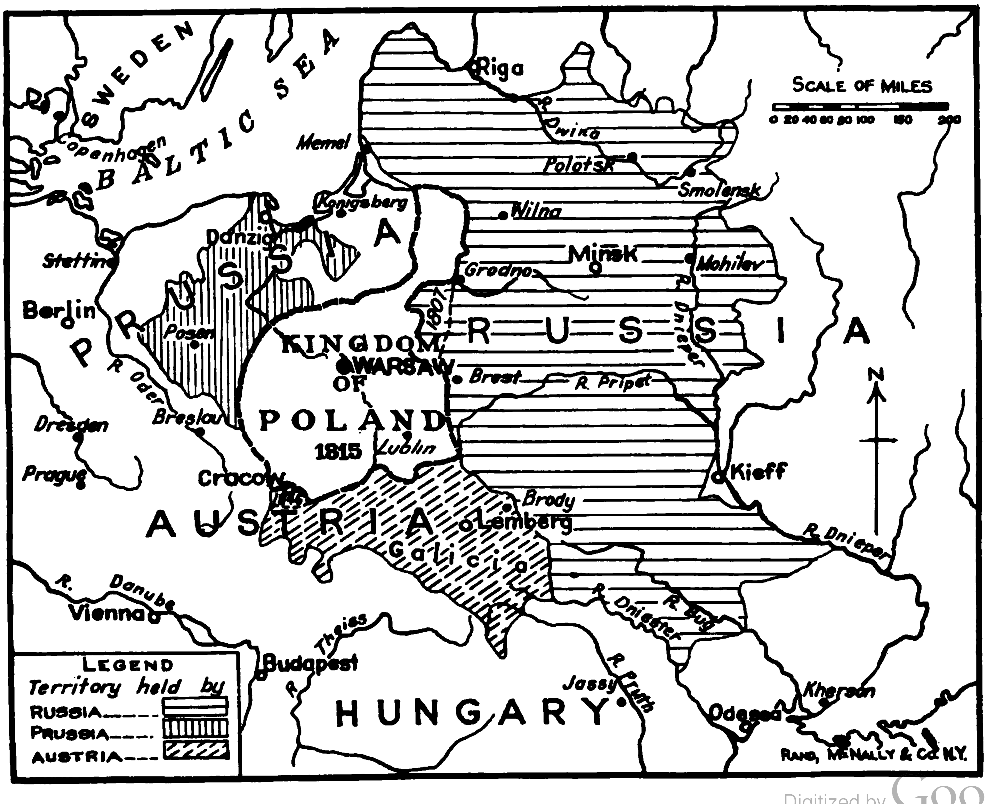
History.— The early history of the Polish people is shrouded in darkness, there being, as in the case of all other Slavic races, no reliable records extant. Certain slight indications point to a residence of shorter or longer duration of the Polish tribes (being grouped then under the names of *Polani, Masovii*, etc., by Roman chroniclers) somewhere along the banks of the Danube. Mythical chiefs, however, in the new homes of the Poles on the Vistula were Lekh and Popiel, and after the death of the last Popiel, a prehistoric hero named Piast seized the crown, and with the fourth of his successors, Miecislav I (962–992) begins the accredited history of Poland. He succeeded in unifying the scattered or isolated tribes between the Vistula and Oder rivers into one state, and in 966 he was converted to Christianity and founded the first bishopric at Posen. His son Boleslav I conquered Pomerania and Danzig, and for a time also Bohemia. By founding the archbishopric of Gnesen he established the independence of the Polish Church from Germany. But during the reign of his son, Miecislav II, the young state fell to pieces by internal discord. Under Casimir I (d. 1058) the nobility rebelled, and a bitter and costly war was waged on Bretislav of Bohemia. However, the German emperor, Conrad II, adjusted matters peaceably. Boleslav II was driven out of the country, because of his intolerable cruelty, and his son and successor was poisoned. The latter was succeeded by Ladislas I (d. 1102), a brother-in-law of Emperor Henry IV of Germany, whose reign was prosperous. But after the death of Boleslav III (1139), his son, Poland was divided up among his four sons. In 1177 Miecislav III once more consolidated Poland, but he was deprived of the throne by an internal rising, and Casimir II reigned in his stead. His son, Leszek (1194–1227) and the succeeding Boleslav V were weak rulers, and whole provinces were estranged by greedy neighbors. Thus, Silesia and Pomerania were lost. There were also constant bloody risings and tribal wars among the pagan Borussians and Lithuanians in the northeast. Dire necessity compelled Conrad of Masovia, a Polish ruler, to beg the aid of the Order of the Teutonic Knights, his neighbors, and enforced by the latter the Poles, in the great and decisive battle on the Sirgune (1233) signally defeated the savage Borussians. There followed the awful period of Mongolian invasion. In the great fight at Wahlstatt, near Liegnitz, Silesia, the Tartars were victorious. A lengthy sort of interregnum followed, during which Silesia was taken from Poland and vast territories were wholly devastated by Mongolian hordes and other enemies. Finally, Venceslas III of Bohemia obtained the Polish crown. But with the latter's demise, Ladislas II (1306–33), scion of the Polish royal race, initiated the long era of Poland's power and wealth, lasting till 1572. He nationalized Cracow completely and was solemnly crowned there, Cracow remaining from 1320 on the real capital of Poland. He also waged incessant and, on the whole, successful war against the Teutonic Order, thus strengthening the Polish national spirit. The son of Ladislas, Casimir the Great (1333–70) was forced to yield up some Polish soil to the Teutonic Order, but in 1366 he wrested Halicz and Vladimir from Russia, and also united Cuyavia with Poland proper. Louis of Hungary, as the nearest heir, reigned 1370–82, and the latter's daughter, Hedviga, was compelled to marry, (1386), the Grandduke Yagello of Lithuania. Thus, the Yagello dynasty, the greatest in Polish history, attained to power, and automatically the union of Poland and Lithuania was effected. Poland thus became by far the most powerful state in eastern Europe. During this time it comprised the kingdom of Poland proper, made up of Cracovia and Silesia, Cuyavia and Masovia, and Lithuania. On 15 July 1410, the great battle of Tannenberg was fought, in which the Teutonic Knights were worsted with great slaughter, and in the Peace of Thorn, 18 Feb. 1411, the Order had to cede Samogitia to Poland. In 1413 the complete incorporation of Lithuania was decreed, and this led to the recognition of the equality of the nobility of both countries, and in 1433 "Red" Russia and Podolia were added to Poland. Yagello died in 1434 and was followed by his son Ladislas III who, in 1440, acquired by inheritance the crown of Hungary as well, but who lost his life in fighting the Turks at Varna, in November, 1444. An interregnum of three years ended with the ascension of Casimir IV to the throne. An almost unintermittent war of 13 years' duration with the Teutonic Knights was successfully ended for Poland in 1466 by a second Peace of Thorn, the order being compelled to yield up West Prussia and Ermland, retaining East Prussia as a Polish fief. Casimir IV (d. 1492) was succeeded in rapid rotation by his three sons, John I Albert, (1492–1501), Alexander (1501–06) and Sigismond I (1506–48), the latter's reign being a glorious and enlightened one. Albert of Brandenburg, the Grandmaster of the Teutonic Knights, in 1525, was allowed sovereign rights over the territory of the Borussians, but only as a Polish vassal. Sigismond's son, Sigismond II Augusta, (1548–72) after great pains finally achieved the consolidation of Poland by an instrument termed the Union of Lublin, in 1569. During his reign Poland reached its greatest territorial expansion of about 380,000 square miles, with a population of some 15,000,000. All the gradually acquired lands, namely, Lithuania, Borussia (or Prussia), Volhynia, Podolia and Ukrainia, were welded with the older dominion into one political and economic entity. From 1572 until the partition, in 1795, Poland was an electoral commonwealth, and this method of choosing rulers, with its inevitable drawbacks, coupled with the lack of a middle class and the serfdom of the peasantry, gradually reduced the efficiency and the power of the whole state, finally ending in complete anarchy. With Sigismond II Augustus the male line of the Yagello dynasty became extinct, and thus the way was opened for internal and foreign intrigue. The first king under the new dispensation was Henry of Valois, brother of Charles IX of France, but Henry fled the country, after a three months' reign, to succeed his brother in France. Two years later, in 1575, the Polish parliament chose Stephen Bathory, the Hungarian. In 1586 the Swedish prince Sigismond was elected king, and he endeavored to unite Sweden with Poland. But Sweden soon tore loose from Poland. This led to a train of hostilities which were only permanently adjusted in the Peace of Oliva, 1660. Prior to this Poland lost Livonia, in 1657, and also the suzerainty over Prussia. John Sobiesky (1674–96), who rescued Vienna from the grip of an enormous Turkish army, was the last Polish ruler of ability, and after his demise the throne practically fell in every instance to the highest bidder, every one of the big Powers purchasing constantly a fraction of the Polish nobility to do yeoman service in Polish state affairs. When the Elector of Saxony, Augustus II, (surnamed The Strong) maintained his candidacy to the Polish throne against that of the Frenchman, Prince Conti, and when he became the ally of Peter the Great of Russia, Poland was hurled into the so-called Northern War. When Charles XII of Sweden was victorious for a time, in 1704, the Diet of Poland declared that Augustus had forfeited the crown and elected Stanislas Leszczynski in his stead. But in 1709 the latter had to renounce his rights, and after the death of Augustus II, in 1733, Stanislas attempted anew, with French aid, to recover the crown. However, Russia and Austria intervened, and Augustus III (son of the second) became king, 1733–63. Later at the instance of Catherine II of Russia, Count Stanislas Poniatovski was chosen king. When Russia, in 1765, championed the cause of the Dissidents, the Confederation of Bar was organized by a faction of nobles in Poland, and this led to internal war and great disorder. This had to serve as pretext for the joint intervention of Russia, Austria and Prussia, culminating in the first partition of Poland, 5 Aug. 1772. By this act of violence, sanctioned though it was in a measure a month later by the impotent members of the Polish Diet, Poland lost all told a full one-third of its remaining territory, the major portion going to Russia, Prussia obtaining the province of West Prussia, and Austria most of Galicia. After this first partition a party of patriots was organized in Poland having the redemption of their country in view. But Russia, by a cunning system of bribery used among the nobility, neutralized these efforts, securing a body of partisans strong enough to issue, at Targovicza a decree declaring the new reform measures passed by the Diet, and more particularly the more liberal Constitution, an infringement of their rights and privileges, on 3 May 1791, and thus being null and void. This was the signal for new civil strife, and that fact again induced the ruler of Prussia, against previous promises, to side with Russia and to consent to a second partition of Poland, 4 Jan. 1793. By its terms Russia obtained the full half of the remaining territory of Poland, with 3,000,000 inhabitants, while Prussia claimed for herself Posen and other parts, with more than a million of population. Polish patriots rose under Kosciusko, but Russian and Prussian armies entered Poland from the north and south, and the Polish forces, after bravely resisting and with initial successes, were overwhelmed. Kosciusko, dictator at Warsaw, was rendered impotent by dissensions among his adherents, and on 10 Oct. 1794 he sustained a decisive defeat at Maciejovicz, and was taken prisoner. Soon after the Russian general, Suvaroff, entered Warsaw and all resistance ceased. The third and last partition was then in order, and by its terms of 24 Oct. 1795, Russia, Austria and Prussia divided the last of the spoils amongst them and Poland as an independent political configuration ceased to exist. Its last sovereign, Stanislas, died a few years later (1798) as a pensioner of Russia.

Napoleon made clever use of Polish aspirations, but the hopes built on him came to nought. True, after a Polish legion of volunteers under Dombrovski had fought valiantly under his colors, he did create a grand duchy of Warsaw. This was done after the Peace of Tilsit, 1807, when he made the king of Saxony, Frederick Augustus I, its sovereign. But this fragment of ancient Poland, although by the Peace of Vienna in 1809 it was added to from Galicia, was merely meant to be a satellite of Napoleon's own ambitious schemes and after 1812 the whole so-called grand duchy of Warsaw went to pieces. By the Vienna Congress Russia again obtained by far the lion's share of Poland. This Russian share now was called the kingdom of Poland and received certain assurances, under international guarantee, and in especial a constitution and administration of its own. In 1818 the first Polish Parliament was opened, but in 1825 already freedom of

POLAND



Partition of Poland 1772, 1793, 1795



Partition of Poland 1807, 1815, 1848

the press and other privileges were curtailed or abolished. After the death of Alexander I of Russia Poland was again governed like a subject province. The consequence was the rising of November 1830 under the inspiration of Mickievicz and Lelewel. The whole of Poland rose. Under General Chlopicki a provisional government was formed, with Prince Adam Czartoryski at its head. The Polish Parliament pronounced the house of Romanoff as unworthy to rule Poland, 21 Jan. 1831. A Russian army of 120,000 under Diébitsch marched upon Warsaw. At Grokhov a battle unfavorable to the Polish cause was fought and the Polish forces had to retire toward Warsaw. Prince Radzivill, who had succeeded Chlopicki, resigned in his turn, but General Skrzynecki failed to beat the Russians at Ostrolenka and the cholera destroyed, besides, more Poles than the war. On 6 and 7 September the Russians took Warsaw by storm and that was the beginning of the end. An amnesty 1 Nov. 1831 contained many exceptions. The constitution was altogether abrogated and a systematic process of Russification was inaugurated. A new revolution was planned and in February 1846 it broke out, but was put down at once. Cracow now lost its autonomous position and was incorporated with Austria. In 1848 as part of the great liberalizing movement in Europe, another rising took place, but was drowned in blood. The movement for a restoration of Poland continued, however, in secret. On 15 Oct. 1861 there were new disturbances in Warsaw. Thousands were incarcerated by the Russians or deported to Siberia and the estates of many nobles were confiscated. On 8 Jan. 1862 a brother of the Tsar, Grand Duke Constantine, became governor of Poland, with a great plan of reforms, and a Pole, Marquis Wielopolski, as coadjutor. But on 3 July an attempt was made to assassinate the grand duke and on 7 and 15 August similar attempts against the life of Wielopolski. On 15 Jan. 1863 the revolution broke out and on 22 January all Poles were called to arms. But neither Mieroslavski nor Langievicz or Czekhovski could make headway against the Russians. Wielopolski retired and General Berg, a Russian, was put in his place. The total failure of the revolutionary movement was, however, brought about by Russia's stratagem in winning the Polish peasantry over to its side, for Russia, by a simple stroke of the pen, made these, instead of serf-like toilers of the soil, freeholders of the land they tilled, freeing them of all forced labor (*robot*) and dues to their titled landlords. Thus, in 1864, the whole movement was dying off. Miliutine and Prince Tcherkaski did the Russifying in Warsaw and by a Russian ukase of 26 Dec. 1865 the entire property of the Catholic Church in Poland was taken over by the Russian government and all Catholic religious matters were decided by the Ministry of the Interior at Saint Petersburg. Lithuania was Russified by Muravieff and “Red” Russia likewise. On 22 Dec. 1865 all persons of Polish blood in the nine Russian western provinces were forbidden by an imperial law to acquire landed property. The University of Warsaw was entirely Russified and only Russian forcibly taught at school. Nearly every Polish civil and administrative institution was rooted out. After 1883 General Gourko more than followed the footsteps of his two predecessors, Albedynski and Kotzebue in stamping out Polish life. In July 1884 another conspiracy was discovered and 200 Poles were either executed or deported to the Siberian mines. To prevent the infiltration of Polish ideas a ukase of 21 Jan. 1885 interdicted the purchase of land by Poles in the 10 western provinces of Russia. All intercourse of Poles with the Pope was barred. While all this was going on in Russian-Poland, in the Polish provinces of Prussia things veered about a good deal, there being no settled policy pursued by the Prussian government toward the Poles. Generally speaking, under William I the Poles were treated far more liberally than was the case during the reign of the last kaiser, William II. In the main the weapons used were economic and cultural. For sundry periods the teaching of Polish was rendered difficult in the Prussian provinces, and this caused deep dissatisfaction. But Bismarck's pet scheme was to create a huge state fund and to buy up Polish estates and, by breaking these up into smaller holdings, to settle Germans on these lands and thus gradually Germanize the whole of the Polish provinces, more especially Posen. In these efforts, though, he and his successors were but measurably successful. But, on the other hand, Polish resistance grew and Polish counter-measures were taken which frustrated the attempts at Germanization. In a material sense, however, the Polish provinces of Prussia flourished more and more. Their economic wealth increased marvelously. In liquid capital there was, as to them, an increase of 350 per cent between 1846 and 1900, and in immobile wealth the figures were similar. As to the Austrian portion of former Poland, i.e. Galicia, the Poles, owing to Austrian internal political requirements, were practically given a free hand. No repression of any kind was practised there. Polish, in fact, throughout Galicia, was the official tongue, to the detriment of Ruthenian, or Ukrainian, although numerically the latter were slightly stronger than the former. At the University of Cracow, the Polish language and literature were fostered and nurtured most carefully, and in the second university of Galicia, that of Lemberg, although situated in the heart of the Ruthenian portion of Galicia, Polish likewise dominated, and Ruthenian was suppressed as far as was feasible. Thus Galicia for a generation or more formed the intellectual rallying point and centre of Polish aspirations, mentality and achievements, and it was in no small part due to this that at the very outbreak of the war, in 1914, the Poles seized instantly upon the opportunity thus afforded them.

From 1914 till the Present Time.—All the same the situation for the Polish race was by no means devoid of complications throughout the more than four years of actual fighting, nor even since the armistice of 11 Nov. 1918. Different currents of political thought just as much as different aims obtained in the three sections into which ancient Poland had been split. The largest and in every respect most important portion, that absorbed by Russia, had as its most powerful political leader for many years prior to 1914 Roman Dmovski, chief of the so-called

Russian democratic faction. This man and his party,— the biggest in Poland — were in favor of remaining under Russian suzerainty, but with far-reaching autonomy, and this mainly for economic reasons. He and his party considered the retention of the Russian market for the young industry and the «intelligentsia» of Poland as absolutely essential, and their goal was, therefore, the democratization of Russia, and a close economic understanding between Russia proper and the new Poland that was to arise out of the ashes of the World War. On the other hand, the Poles of Galicia were, in their majority, in favor of the establishment of a united Poland, of which the most important nucleus was to be Galicia, the Russian and a small part of Prussian Polish portions to be added, and the whole to be under the rule of the Austrian archduke Charles Stephen, a man of avowedly strong Polish sympathies and affiliations (two of his daughters married to Princes Czartoryski and Radzivill), either as a new and separate realm or else united to the Hapsburg crown. Over in Prussia minds were still more divided. In many of those districts where the men of Polish race were in the minority the latter inclined to the view that they ought to cast their lot with the rest of Prussia. Meanwhile the three factions of the Polish race had to fight each other, as parts of either the Russian, Austrian or German contingents, on the field of battle. In Austria alone, at the very beginning of the war, Polish legions were formed, and these gradually were put under command of General Pilsudski, an able commander. Then came the Russian reverses, and finally the establishment of a new «Poland» under the ægis of, first, Germany, and, next, Austria-Hungary, and the entire collapse of Russia and at last the forming of the Soviet government under Bolsheviki control. From week to week, from day to day almost, at least during those crucial times, the views and purposes of the Polish masses shifted and changed of necessity. That neither Austria nor Germany meant to go as far as the most forcible and influential of the Polish patriots wanted to go became plain very soon. Jan Ignace Paderewski, known to the whole world so far only as a master musician, then by skilful diplomacy, being, besides, at an early date convinced of the ultimate collapse of the two Central Powers, made himself master of the situation on Polish soil by the tremendous influence his word had with the Allied Powers and the United States government. By his strenuous labors and those of other Polish patriots, notably those of Dmovski, the rejuvenation, or rather the rebirth, of Poland became a fact in an almost incredibly short space of time. The victorious powers that had vanquished Germany and Austria pledged themselves to the re-establishment of Poland with boundaries drawn wide enough to make her a formidable neighbor and potential foe of post-bellum Germany, and a resilient buffer state against the spread of Bolshevism. For the moment it is too early to describe or predict the economic future and the other essential features of the new Polish commonwealth. See Lithuania; Polish Language; Polish Literature; Ruthenes; Slavs; War, European.

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Wolf von Schierbrand.

POLANGUI, pō-län'gē, Philippines, a town in the province of Albay, Luzon, on the Inaya River, 18 miles northwest of Albay, the provincial capital, near the boundary of Ambos Camarines (Sur). It is also on the main road and its situation gives excellent advantage for trade in hemp. Pop. 7,960.

POLAR, or ICE, BEARS. See Bears.

POLAR CIRCLES, two imaginary circles of the earth parallel to the equator, the one north and the other south, distant 23° 28′ from either pole. The surfaces enclosed by these circles are known as frigid zones.

POLAR CLOCK, a tube, invented by Wheatstone, containing a polarizing apparatus, turning on an axis parallel to that of the earth. It indicates the hour of the day on an hour circle by being turned toward the plane of maximum polarization of the light of the sky, which is always 90 degrees from the sun. See POLARIZATION OF LIGHT.

POLAR DISTANCE, *in astronomy,* the angular distance of any point on a sphere from one of its poles; more especially, the angular distance of a heavenly body from the elevated pole of the heavens. It is measured by the intercepted arc of the circle passing through it and through the pole, or by the corresponding angle at the centre of the sphere. According as the north or south pole is elevated we have the north polar distance or the south polar distance. The sum of the two polar distances of any point is obviously 180 degrees.

POLAR EXPLORATION. See POLAR RESEARCH.

POLAR RESEARCH. American exploration in the Arctic divides itself readily into three parts — the expeditions, 1851-55, incident to the Sir John Franklin search; those promoted by the United States government, 1870-72 and 1881-84, and those projected, financed and led by Rear Admiral Robert E. Peary, U.S.N., 1891-1909. The first American ships to participate in the Franklin search were the *Advance* and *Rescue,* in command of Lieutenant De Haven, which leaving New York 24 May 1850, searched the Greenland coast as far north as practicable, returning late the same year, with no tidings of the lost explorer. Henry Grinnell, a New York merchant, who had given liberally to the work, renewed his offer of aid, and equipping the brig *Advance,* dispatched her from New York, 30 May 1853, in command of Elisha Kent Kane, U.S.N., surgeon of the De Haven Expedition, with John Brooks as first officer and Capt. J. Wall Wilson navigator. The *Advance* wintered in Rensselaer Harbor, on the western coast of Greenland, 78° 37′ N., but, unable to free herself from the ice, was detained a second winter, during which a party retreated about half-way to Cape York, but were obliged to turn back, and on 17 May 1855 the whole company, with their boats, left the *Advance* and after an arduous journey reached Upernavik 9 August. Dr. Kane found no trace of Sir John Franklin, but his explorations by sledge were extensive and the scientific results of his expedition valuable. William Morton, leading one of the sledge parties, reported that at Cape Constitution (82° 27′ N.) on 21 June 1854 he had seen the open Polar Sea, and upon this statement much subsequent discussion was predicated. One death, that of Christian Ohlsen, carpenter, oc-

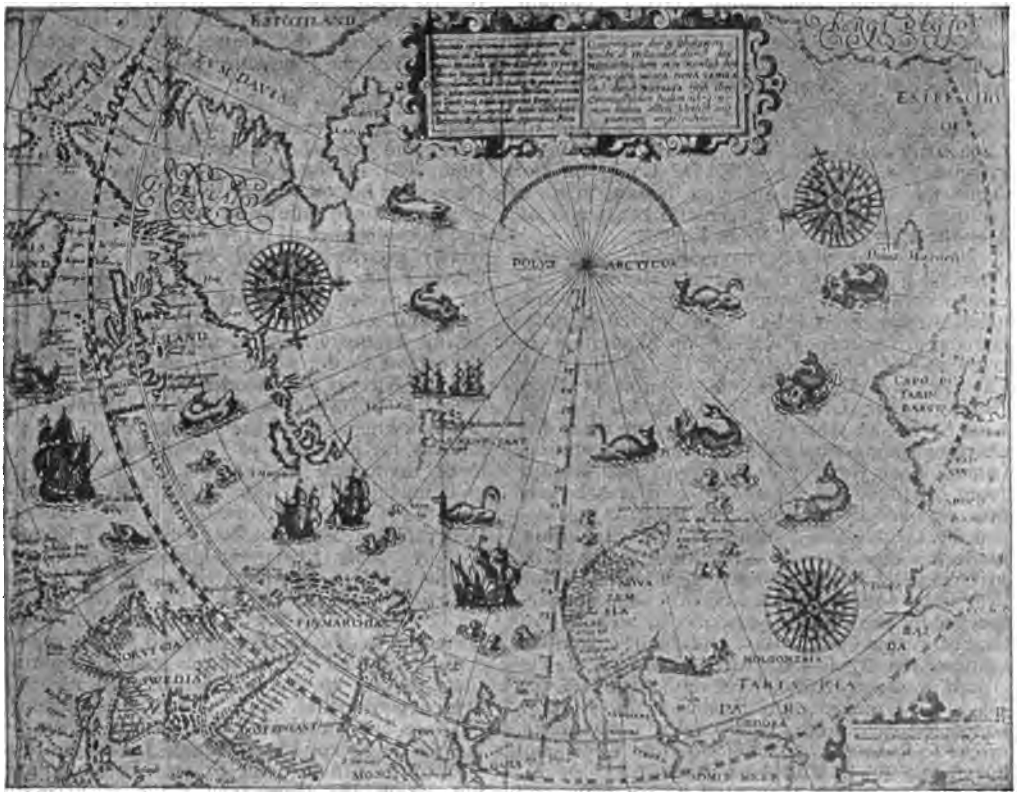


Photo. by Underwood and Underwood, N. Y.

Authentic Record of Earliest Known Arctic Exploration 1594-95

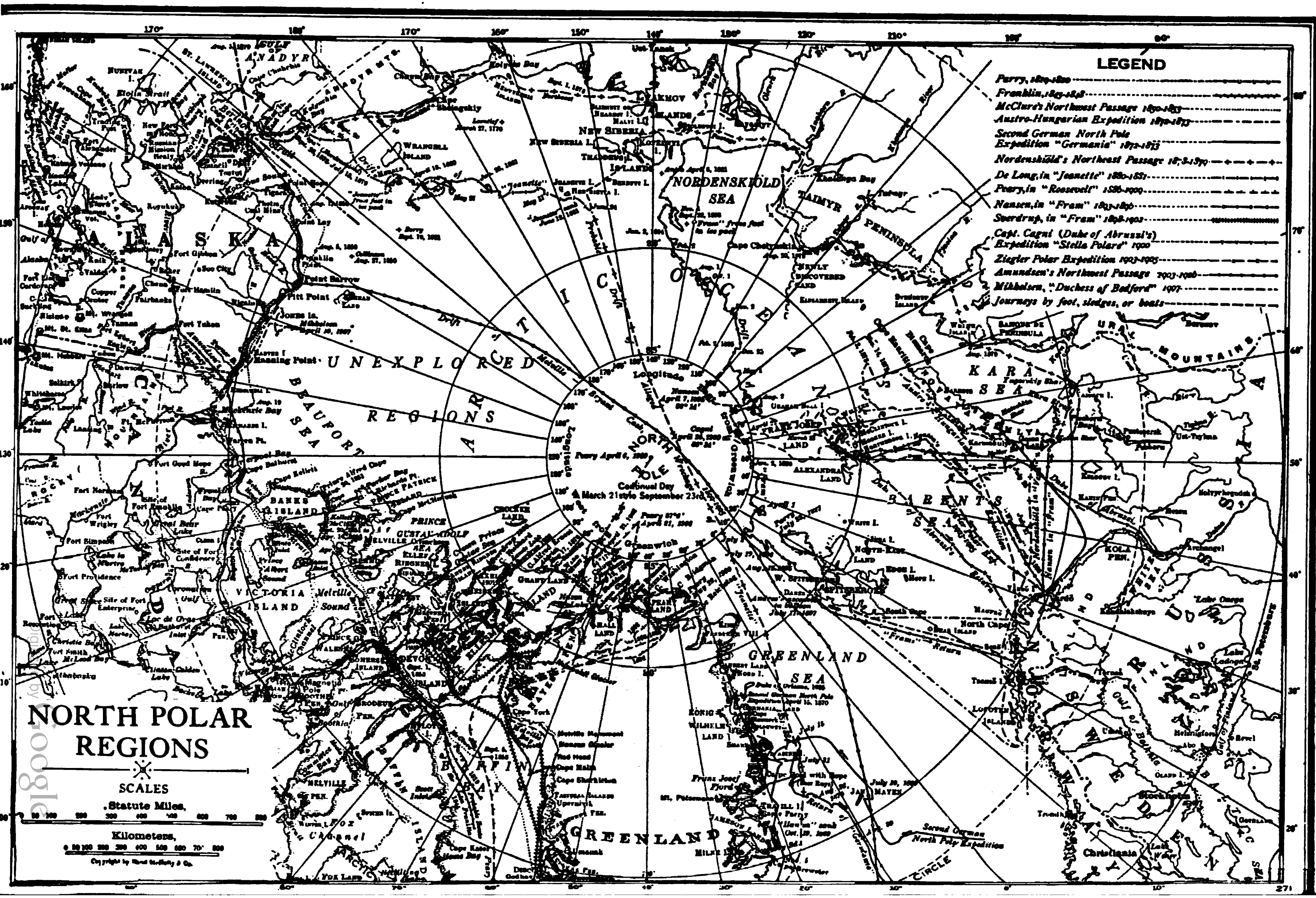
The earliest illustrations of Arctic Exploration by Gerrit-Veer who accompanied the Dutch Expedition led by William Barents, 1594-95, the first attempt by Europeans to visit the Arctic Circle.

curred 12 June 1854, in the Kane Expedition, of which the last survivor, Capt. Amos Bonsall, carpenter, died in Philadelphia, 18 Oct. 1915.

In 1860 Dr. Isaac I. Hayes, surgeon of the Kane Expedition, returned to the North in the schooner *United States,* and during the spring of 1861 accomplished a memorable sledge journey, crossing Smith Sound and carrying the flag of his country to Cape Lieber, Grinnell Land, 81° 35′, and losing by death the astronomer of his party, Sonntag, at the head of Foulke Harbor, the winter quarters of the *United States.* In 1871 Capt. Charles Frederick Hall, who had extensive experience, principally among the Eskimos of Labrador and Baffin Land, sailed from New York on the steamer *Polaris,* outfitted and equipped by the United States, and on 3 September went into winter quarters in Thank God Harbor, lat. 81° 38′ N., long. 61° 44′ W. Captain Hall, on 10 October, left on a sledge trip, reaching 82° 2′ N., and on 8 November, after an illness of a few days, died on board the *Polaris,* Capt. Samuel Buddington succeeding to the command. Scientific investigations were continued during the winter, but no extensive field work attempted, and on 12 Aug. 1872 the *Polaris* started south. During the night of 15 October the floe to which the ship had been fastened parted from it, and from that date 19 men, women and children drifted over 1,500 miles, until they were picked up 30 April 1873 off Grady Harbor, Labrador, by the Newfoundland sealer *Tigress.* Captain Buddington and the remainder of the party wintered at Lifeboat Cove, north of Littleton Island and, retreating southward in the spring, were picked up 23 June by the whaler *Ravenscraig* and landed in due course at Dundee, Scotland, a relief expedition under command of Capt. afterward Adm. D. L. Braine, with Lieut. afterward Capt. George F. De Long, of the *Jeannette,* second in command, having made a fruitless search of the Greenland coast and of Melville Bay as far as Cape York.

The United States, participating with the principal European countries in a system of circumpolar weather stations, on 21 July 1881 dispatched from Saint Johns, Newfoundland, in the chartered steamer *Proteus,* an expedition in command of Lieut. Adolphus G. Greely, Fifth Cavalry, U.S.A., which took station at Lady Franklin Bay, Grinnell Land, lat. 81° 44′ N., long. 64° 45′ W., the *Proteus* returning after discharging supplies and equipment. The station, named Fort Conger in honor of the senator from Michigan, to whose efforts it was largely due, was amply equipped, and early in the season Dr. Octave Pavy, surgeon of the expedition, made a sledge journey along the eastern coast of Grinnell Land to its extreme northern point, near Cape Joseph Henry, and other field parties worked in the interior, discovering deposits of coal at Water Course Bay, a few miles from the station. In April 1882 Lieut. James B. Lockwood, accompanied by Sergeant (now General) David L. Brainard and Frederick, an Eskimo, supported by other members of the party, crossed Robeson Channel to the Greenland coast, and on 5 May 1882 reached 83° 24′ 5″, the farthest north then attained by man, and for many years the highest reached by the American flag. On 9 Aug. 1883 the entire party retreated from Fort Conger, and in September went into winter quarters near Cape Sabine, whence they were, on 26 May 1884, rescued by Capt. W. S. Schley, commanding the *Bear* and the *Thetis,* 19 of the party, including Lieutenant Lockwood, having perished from starvation. The scientific work of the Greely party was of the first importance, and its magnetic and meteorological data, all of which were preserved, complete and valuable. A privately equipped expedition, that of the *Jeannette,* under Lieut. George W. De Long, U.S.N., left San Francisco in 1879, and passing through Bering Strait, entered the ice at about the 83d parallel. The *Jeannette* was crushed and sunk on 12 June 1881, when in lat. 77° 14′ 57″ N. and long. 154° 58′ 45″ E., and upon retreating to the Siberian coast in three parties, one boat commanded by Lieut. Charles W. Chipp, U.S.N., was separated from the others, and never again heard of. Captain De Long, reaching the mouth of the Lena Delta, perished from starvation, only two of his party surviving, while the third boat under command of Chief Engineer, the late George W. Melville, U.S.N., reached land in safety without the loss of a man. The British government in 1875 dispatched the *Discovery,* Capt. George Nares, and the *Alert,* Commander Albert H. Markham, by way of Smith Sound to the north, during the following winter sledge parties accomplished much work to the westward of Cape Joseph Henry, carrying the reconnaisance to 75° 30′ W., while a party advanced from Cape Hecla directly over the sea-ice to the Pole to 83° 20′. Both ships were beached during the winter, but were successfully floated the following summer and returned in safety.

Lieut. Robert E. Peary, U.S.N., having, in 1886, made a summer's reconnaissance of the Greenland ice-cap, sailed from New York 6 June 1891 in the *Kite,* accompanied by Mrs. Peary and his own party of five, the expedition being sustained wholly by his private resources and the assistance of a few friends. Establishing winter quarters on the eastern side of McCormick Bay, lat. 78° 10′, long. 69° W., the winter was passed in preparation for the land journey, and on 10 April 1892, accompanied by Eivind Astrup, Peary began his attempt to cross Greenland to the northeast, which ended on 4 July at Navy Cliff, Academy Bay, lat. 83° 27′, long. 61° 10′, where he gained an unbroken and commanding view of the Arctic Ocean, demonstrating the insularity of Greenland, an achievement for which he subsequently received the gold medal of the Royal Geographical Society and the Collom gold medal of the American Geographical Society. Returning in 1893 with a larger party Peary established headquarters at the head of Bowdoin Bay, also an arm of Inglefield Gulf, lat. 77° 43′, long. 63° 10′, where, on 12 Sept. 1893, Marie Ahnighito Peary was born, and in March 1894 renewed his attempt to cross the inland ice-cap and to push his explorations farther to the northward. An unprecedented equinoctial storm and a plague among his dogs frustrated his plans, and on 29 August the party, except Peary, Hugh J. Lee and Mat Henson, returned to the States. In the following spring the three men made a successful attempt to cross again the ice-cap, though failure to recover the provisions cached the previous year, 120 miles from headquarters, was a serious obstacle and compelled return with only


LEGEND
Parry, 1819-1820
Franklin, 1845-1848
McClure's Northwest Passage 1850-1853
Austro-Hungarian Expedition 1872-1874
Second German North Pole Expedition "Germania" 1872-1873
Nordenskiöld's Northeast Passage 1878-1879
De Long, in "Jeanette" 1880-1881
Peary, in "Roosevelt" 1886-1909
Nansen, in "Fram" 1893-1896
Sverdrup, in "Fram" 1898-1902
Capt. Cagni (Duke of Abruzzi's) Expedition "Stella Polare" 1900
Ziegler Polar Expedition 1903-1905
Amundsen's Northwest Passage 1903-1906
Mikkelsen, "Duchess of Bedford" 1907
Journeys by foot, sledges, or boats
NORTH POLAR REGIONS
SCALES
Statute Miles
Kilometers
ARCTIC OCEAN
UNEXPLORED REGIONS
NORTH POLE
Continual Day March 21st to September 23rd
Peary April 6, 1909
ALASKA
CANADA
GREENLAND
GREENLAND SEA
BARENTS SEA
KARA SEA
NORDENSKIÖLD SEA
BEAUFORT SEA
BAFFIN BAY
GULF OF ANADYR
TAIMYR PENINSULA
NEW SIBERIA ISLANDS
WRANGELL ISLAND
BANKS ISLAND
VICTORIA ISLAND
PRINCE PATRICK
FRANZ JOSEF LAND
SPITZBERGEN
NORWAY
SWEDEN
FINLAND
URAL MOUNTAINS
ARCTIC CIRCLE
Greenwich

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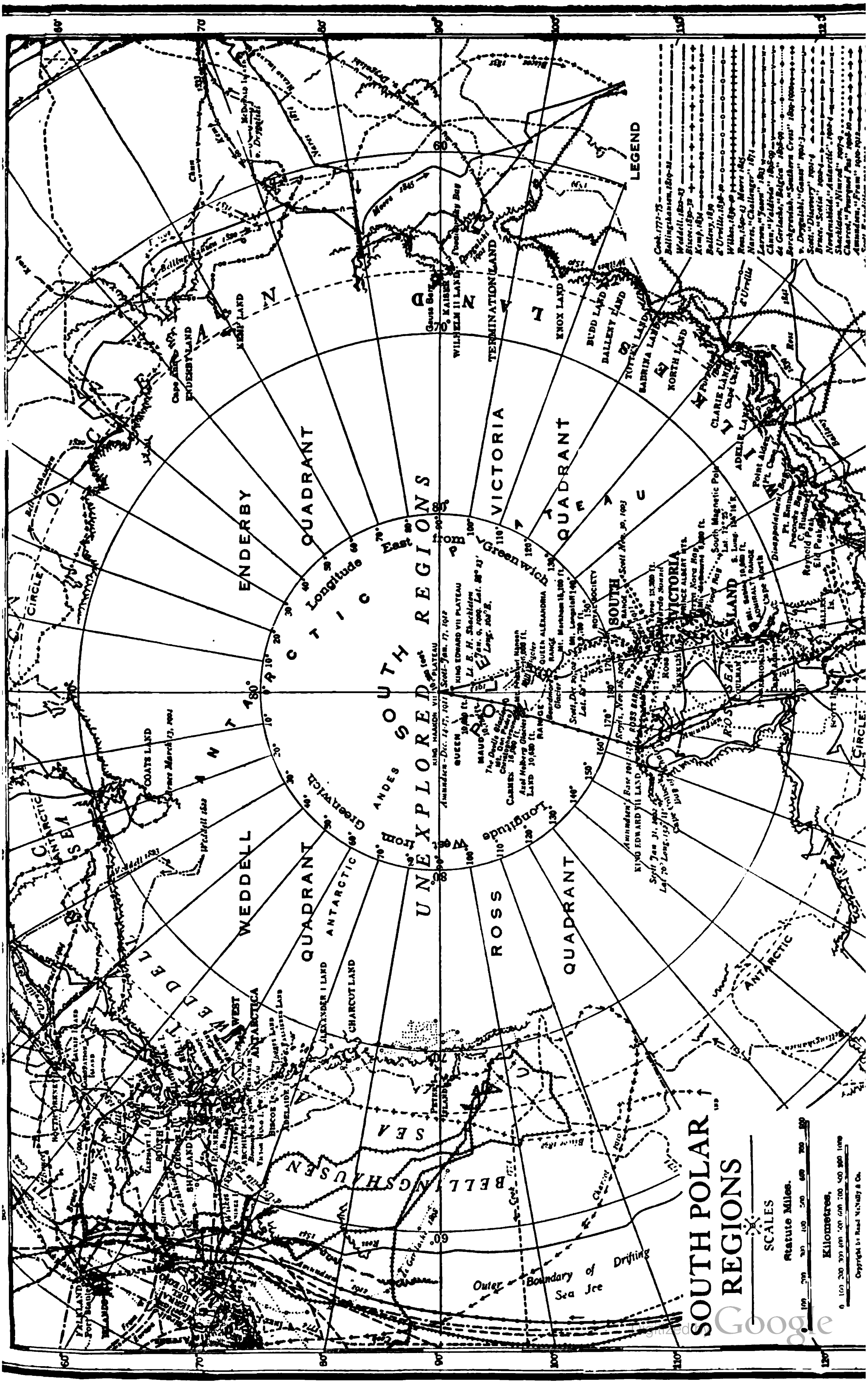
SOUTH POLAR REGIONS
SCALES
Statute Miles
Kilometres
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LEGEND
Cook, 1772-75
Billingshausen, 1819-21
Weddell, 1822-23
Biscoe, 1830-33
Kemp, 1833
Balleny, 1839
d'Urville, 1838-40
Wilkes, 1839-40
Ross, 1840-43 Moore 1845
Nares, "Challenger" 1874
Larsen, "Jason" 1893
Chun, "Valdivia" 1898-99
de Gerlache, "Belgica" 1897-99
Borchgrevink, "Southern Cross" 1899-1900
v. Drygalski, "Gauss" 1901-3
Scott, "Discovery" 1901-4
Bruce, "Scotia" 1902-4
Nordenskiöld, "Antarctic" 1901-3
Shackleton, "Nimrod" 1907-9
Charcot, "Pourquoi Pas" 1908-10
Amundsen, "Fram" 1910-12
UNEXPLORED SOUTH REGIONS
SOUTH POLE
ENDERBY QUADRANT
VICTORIA QUADRANT
ROSS QUADRANT
WEDDELL QUADRANT
ANTARCTIC CIRCLE
WEDDELL SEA
ROSS SEA
BELLINGSHAUSEN SEA
Longitude East from Greenwich
Longitude West from Greenwich
ENDERBY LAND
KEMP LAND
COATS LAND
KAISER WILHELM II LAND
TERMINATION LAND
KNOX LAND
BUDD LAND
DALLEY LAND
SABRINA LAND
NORTH LAND
CLARIE LAND
ADELIE LAND
SOUTH VICTORIA LAND
KING EDWARD VII LAND
KING EDWARD VII PLATEAU
QUEEN MAUD RANGE
QUEEN ALEXANDRA RANGE
WEST ANTARCTICA
ALEXANDER I LAND
CHARCOT LAND
PETER I ISLAND
SOUTH SHETLAND
FALKLAND IS.
South Magnetic Pole
Outer Boundary of Drifting Sea Ice
ANDES

about 15 miles farther north than had been made two years before. In 1896 and 1897 Peary again visited Greenland, bringing home on the former the smaller, and on the latter voyage the larger, the 90-ton meteorite, which had been seen 70 years before by Sir James Ross at Meteor Island, near Cape Sabine, and which had furnished the natives with tools and cutting implements, and is the largest known meteor in the world. Having organized the Peary Arctic Club, of a few of his personal friends, on 4 July 1898 Peary sailed from Saint Johns, Newfoundland, in the *Windward;* wintered in her in Allman Bay, lat. 79° 10', long. 75° 20', on the west side of Smith Sound, rectifying and re-charting the whole Bache peninsular and Buchanan Sound country, and on 1 Jan. 1899, sledging along the ice-foot, reached Fort Conger, isolated since General Greely's departure 18 years before. In June Peary pushed westward, crossing the divide of Grinnell Land, and looked down upon the open and ice-free sea beyond. Leaving his headquarters at Etah early in March 1900 and Fort Conger, 15 April, he reached «Lockwood's farthest,» 8 May, and a disintegrated pack and an open sea preventing further advance to the Pole, rounded the northern end of the Greenland archipelago, discovering the most northern known land in the world, which he named in honor of the president of the Peary Arctic Club, Cape Morris K. Jesup. Pushing his explorations southeastward to 82° 10', 61° 30' W., on 21 May Peary saw before him to the south the peaks of Independence Bay, which he had discovered nine years before, realized that the demonstration was complete, and that the mystery which had surrounded the northern end of Greenland for a thousand years had been dispelled. The winter of 1900–01 was passed in the field, near Lake Hazen, Grinnell Land, and on 6 May 1901 Peary joined the *Windward* with Mrs. Peary and Miss Peary on board, which had been ice-bound since the previous September at Payer Harbor, near Cape Sabine. Wintering at Cape Sabine, 1901–02, in February, accompanied only by Matthew Henson and natives, Peary returned to Fort Conger and endeavored to attain the Pole, from Cape Hecla as a point of departure, but on 16 May, at 84° 17', the highest then attained by the American flag, he was compelled by insurmountable pressure ridges and the condition of the ice to give up the attempt, and returning to Cape Sabine he was met, 5 August, by the *Windward* with Mrs. Peary on board, and reached Sydney, C. B., 15 September, thus concluding 12 years of arduous and most successful work. In the spring of 1906 he succeeded in reaching 87° 6' north latitude in the *Roosevelt,* or within about 203 miles of the north pole, thus creating another «farthest north» record.

In 1893 Fridtjof Nansen in the *Fram,* specially constructed for the purpose, entered the ice off the northern coast of Asia and for the next three years drifted northward, one of the objects of the expedition having been to demonstrate the theory of the drift from east to west. On 12 March 1896 Nansen, accompanied by Lieutenant Johansen, left the *Fram* in lat. 84° and with dogs and sledges pushed his way over the sea ice poleward to 86° 14' on 20 May, when farther advance was impossible. Retracing his course Nansen and Johansen finally, without dogs, landed on the northern shore of Franz Josef Land, where in a hut and subsisting upon seal and walrus meat the two explorers passed the winter. While advancing southward on 12 May 1897 they were descried by Frederick Jackson from his headquarters at Cape Flora, and remained with him at his camp until his return the following summer. The *Fram,* under command of Captain Sverdrup, after Nansen's departure, drifted still farther to the north, attaining only 18 miles less than Nansen's highest, and by almost superhuman exertion, was broken out of the ice later in the season, reaching Tromsö but a few days after Nansen. The entire party and ship returned together to Christiania, from which they had departed three years before.

Alfred C. Harmsworth (now Lord Northcliffe), the English newspaper proprietor, in 1892 dispatched an expedition led by Frederick G. Jackson, with Lieut. Albert H. Armitage, R. N., second in command, to Franz Josef Land for a thorough reconnaissance of the archipelago and an advance to the north as far as practicable. The *Windward* remained ice-bound near Jackson's headquarters at Cape Flora for the first winter, and for three succeeding summers visited the station with supplies and reinforcements. The work of Jackson included the charting and mapping of a large portion of the Franz Josef Land Archipelago, though in consequence of unfavorable conditions not attaining a latitude higher than had been previously accomplished. Mr. Harmsworth later presented the *Windward* to Commander Peary.

In 1899, Prince Luigi, Duke of the Abruzzi (q.v.) in the *Stella Polare,* reached Teplitz Bay, Rudolf Land, where the ship was beached and winter quarters established. The following spring the sledge parties led by Capt. Umberto Cagni achieved, on 25 April, 86° 33', the highest latitude then attained by man, for which achievement both the Prince and Cagni received upon their return gold medals from the Royal Italian Society and recognition by the scientific bodies of the world. Interest in these achievements is increased by the fact that during the Turco-Italian War of 1912, the Duke D'Abruzzi served as commander-in-chief and Captain Cagni as admiral of a division of the fleet operating against the Tripolitan coast, the latter commanding the landing party, and both continued during the great European War, beginning in 1914, to exercise similar commands in the navy of their country. Some other attempts upon the Pole by the Franz Josef Land route have been made by Walter Wellman and Evelyn B. Baldwin, the latter under the patronage of William Ziegler, whose second expedition, led by Anthony Fiala, left Tromsö in July 1903.

Capt. Otto Sverdrup, of the Nansen expedition, sailed in 1899 to Smith Sound in the *Fram,* and after having been ice-bound for the winter of 1899–1900 in Rice's Strait, in the autumn of the latter year entered Jones' Sound, where he remained for the next two winters, pushing a line of the extensive exploration northward and westward by the former of which he practically determined the insularity of Grinnell Land and by the latter carrying the flag of his country to

85° 42′ and definitely mapping much coast which had before been inaccurate or imaginary. Captain Sverdrup's surgeon, Dr. Jensen, died during the first winter in Rice's Straits, but with this exception his entire party, after a diligent and arduous three years, returned to Norway in good health (1903).

The year 1909 was particularly eventful in polar research. Not only was the North Pole actually reached by Commander Peary on 6 April, but all previous Antarctic records were eclipsed by Sir E. Shackleton when he on 9 January came up to within 111 statute miles of the South Pole.

Peary prepared for his sixth and successful attempt to discover the North Pole as early as the summer of 1908, but delay on the part of his shipbuilder prevented an earlier start than on 17 Aug. 1908. His vessel was the *Roosevelt*, and his scientific assistants were as Ross G. Marvin, of Cornell, George Borup, of Yale, and D. B. MacMillan, of Bowdoin. The company included besides, 66 men and 140 dogs. The entire equipment was the very best, and the plan the ripest the experienced explorer could devise. Five separate detachments, each independently equipped and fully provisioned, were to advance a certain distance to relieve or replenish some one of the various divisions at a point definitely prearranged and then return. In this way, one division after another having turned homeward, there remained but a single party to make for the goal.

Setting out from Etah on 17 Aug. 1908, the first objective, Cape Sheridan, was reached on 5 September. There, on the shore of the Arctic Sea, the party wintered. Winter camp was broken on 15 Feb. 1909 and the first of the five detachments proceeded toward Cape Columbia. In accordance with the general plan, relieving parties were met and turned back as soon as their purpose was accomplished. Only five men made the final dash to the Pole — Peary, Matthew A. Henson (Peary's colored servant), and four Eskimos. Five forced marches, under unusually favorable circumstances, brought the long-sought-for goal to view on 6 April 1909. The entire distance from mainland to Pole, 475 statute miles, was covered at the unprecedented average speed of 13 miles per day — a feat which in itself would have made the expedition noteworthy.

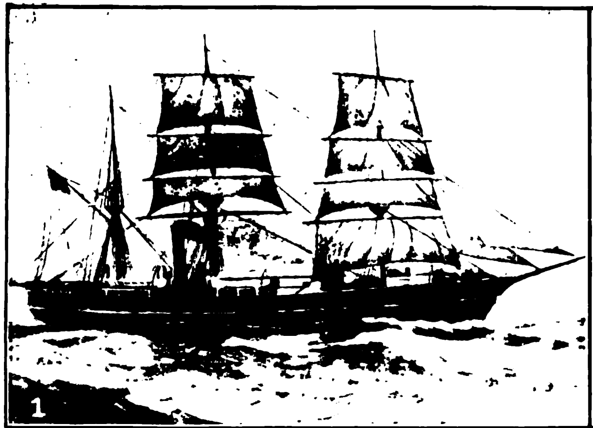
Observations gave 89° 57′ just before the party finally halted. During the 30 hours spent there, a temperature of from — 12° to — 30° F. prevailed at the Pole. For the most part, the sky was clear, and, save for the "chalky" whiteness of its ice, nothing whatever struck the expectant observers. As was anticipated, no life of any kind was found at the Pole. After making all necessary records and photographs, the party planted the American flag to mark the imaginary pole and turned homeward.

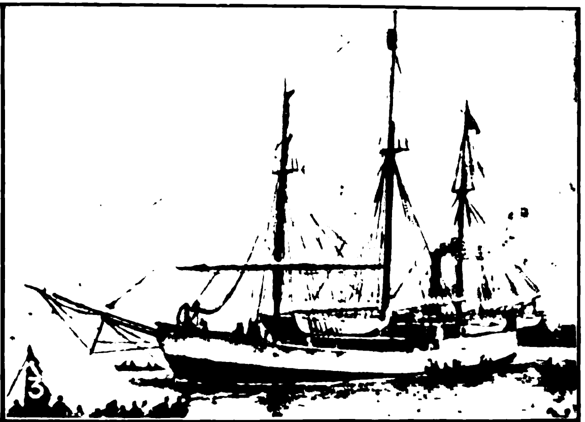
The homeward marches, greatly favored by paths and stations made in the outgoing expedition, were made at an average daily rate of 29.5 miles — more than double that of the outgoing average. The *Roosevelt*, which was used also on the return voyage, reached Indian Harbor on 6 Sept. 1909. From there the news of the great achievement was cabled to the world.

Apart from the momentous discovery itself, data of scientific importance were gathered along the way; of these, the most important were the soundings made at intervals, which furnished the first conclusive proof of the vast oceanic depths north of the American Arctic lands. In addition, the existence of large land masses still unknown has become even more doubtful since this expedition.

Rear Admiral Peary submitted to the National Geographical Society his data and proof and its special committee found in them conclusive evidence that he had reached the North Pole on 6 April 1909. In recognition of his great achievement, numerous scientific societies have awarded him gold medals and otherwise honored the American polar explorer. See articles on PEARY and COOK, FREDERICK ALBERT.

America and Canada were, in 1913, rivals in the North. The American Museum-Geographical Society-University of Illinois expedition, whose departure had been postponed for a year through the tragic death of George Borup in an unsuccessful attempt to rescue a comrade from drowning, left New York 4 July with the unknown Crocker Island which Peary believed he descried seven years before from Cape Thomas Hubbard, as its objective. Ensign Fitzhugh Green, U.S.N., Professors Ekblaw, geologist, and Tanquary, naturalist, of the university, and Surgeon Hunt of Bowdoin, made the party under the leadership of Donald B. MacMillan, leader of a Peary 1908 supporting party from Cape Columbia. The expedition, delayed en route, arrived in Smith Sound too late to reach its proposed base, Buchanan Bay, wintered at Etah, whence during the next spring MacMillan and Green, crossing Ellsmere Land, advanced far out upon the sea ice to the location as nearly as could be fixed from Peary's data, not only to find no land but no indications of it. Appearances like those which greeted Peary were clear and positive, both before leaving the mainland and enroute, but MacMillan's conclusion that the land which they appeared to indicate did not exist was positive. Returning by slow marches to his headquarters at Etah, the winter of 1914–15 was spent in such field work as circumstances permitted, no relief ship having arrived. Late in the summer of 1915 Prof. Edmund O. Hovey of the Museum on the auxiliary schooner *George B. Cluett*, left to bring the MacMillan expedition home, only to report, nine months later, that, disabled, the schooner had failed to reach Etah and had wintered in Parker Snow Bay and he, himself an invalid, had turned back from Cape York to the Danish North Star Bay Station, while two others of the party had proceeded to the South Greenland settlements to report and bring relief. Professor Tanquary arrived in New York June 1916 by way of Copenhagen. The Museum chartered the Danish steamer *Danmark* to proceed to Smith Sound, gather the scattered members of the expedition and return with them to civilization. Nothing, however, was heard from the *Danmark*, which, it was later learned, had been hopelessly beset in the ice of Smith Sound and in August 1917, Capt. Robert A. Bartlett, in the chartered *Neptune*, brought home from the Etah base, MacMillan, Ekblaw and Hunt. Professor Hovey arriving at New York on the same day, by way





(Drawn from the painting by A. Opertl)

By permission of The Associated Sunday Magazine

1 The Discovery 2 The Gauss 3 The Fram 4 The Roosevelt (Peary Ship) 5 The Panther 6 The Polar Star

of the Danish Greenland-Copenhagen mail steamer.

Vilhjalmur Stefansson, whose «blond Eskimo» expedition brought him into the front rank of Arctic explorers, left Victoria, British Columbia, in June 1913 in command of the first official Canadian Arctic expedition, more complete in personnel and equipment than almost any entering the North for half a century. The *Karluk*, in command of Capt. Robert A. Bartlett, with two auxiliaries, which passed through Bering Strait and on 24 September, while Stefansson with two or three companions was on shore, drifted in fog to sea with the pack; the Southern scientific party, in command of Dr. Anderson, working upon the land, had, however, fortunately been landed before this untoward event. In the following May, Captain Bartlett, accompanied by a single Eskimo, arrived at Saint Michael's, Alaska, reporting that after three months' drift the *Karluk* finally sank 27 Jan. 1914 and that the greater part of the ship's party had reached Wrangel Island, from which he, with his comrade, had made a sledge journey over the ice, along the ice-floe to Emma Harbor, Siberia. The entire scientific staff, leaving the ship before her final loss, had perished in a vain attempt to reach safety. Late in the winter the Wrangel Island company were rescued, except three who died from exposure and illness, and were ultimately returned to their homes. Stefansson, however, wintering at Captain Martin and the nearby Eskimo villages, ignorant of the fate of the *Karluk*, left the land, late in March, upon a due north course, seeking the unknown landmass which years before with his leader, Capt. Ejnar Mikkelsen of Denmark, he had sought in his Duchess of Bedford expedition. Nothing was heard from Stefansson during the whole of 1914. Not until 1915 did Stefansson, having in the meantime by many of his friends and competent explorers been given up for lost, return to announce that having wintered safely on Banks Island he had, in 1915, resumed the reconnaissance and in May of that year discovered in approximately 73.43 N. and 115.43 W. land which human eye had never before seen; traversing a coast line northeast and southwest, apparently 100 miles, but without penetrating the interior. Stefansson, as the season was drawing toward the close, retraced his steps, crossed the ice-free Banks Land after a short stay at his base, where he learned of the loss of the *Karluk*, chartered immediately the *Polar Bear*, determined to push her in the farthest north winter quarters, whence in the spring of 1916 he would endeavor further to develop the outline and to map the land which belongs to him by right of discovery. Late in 1917 Stefansson returned to his land base and at Herschel Island fell seriously ill of typhoid. In the early spring of 1918 he made a difficult overland journey by dog sledge to Fort Yukon, whence after months in a hospital he returned to New York and Ottawa. Discussion of his data and collections will occupy several years, prior to publication by the Canadian government.

Two expeditions, depending on the drift of marine currents, were undertaken in 1918, Roald Amundsen from Christiania in a specially constructed ship, thence to a point on the Siberian Coast, whence he proposed to enter the ice and drift four or five years, possibly to open water or land on the Western Hemisphere, and Storkersen's and Andersen's, Stefansson's veterans, whose attempt to drift with the ice westward from a point due north of Alaska, to the Siberian Coast, was frustrated by unfavorable conditions, leaving them to make the best of their way back to land, subsisting meanwhile on the food resources of the Arctic Ocean.

Among Antarctic explorations, those of Sir E. Shackleton during 1908–09, stand preeminent. Starting from Erebus Land, South Victoria Land, in the spring of 1908, four important land journeys were made by Shackleton's expedition.

The first culminated in the ascent of the Erebus volcano — an altitude of 13,379 feet — on 10 March 1908. The second journey was for the South Pole. It was begun on 29 Oct. 1908 and lasted five weeks. Traveling over the Great Ice Barrier, the party passed Scott's farthest south, to find the coast of the Antarctic Continent directly to their right. Pushing ahead, it found itself within 111 statute miles of the South Pole on 9 Jan. 1909, when farther progress was rendered physically impossible through lack of food. On 1 March this party returned to winter quarters. Even while this expedition was still in progress another was under way to the northwest. This party passed across the interior ice cap and reached the South Magnetic Pole — 72° 25′ S. lat., 155° 16′ E. long. — on 1 Jan. 1909. A fourth party traveled far inland up the Ferrar glacier. The entire expedition returned home in the spring of 1909.

See ANTARCTIC REGIONS, — *Exploration.*

HERBERT L. BRIDGMAN,
Secretary Peary Arctic Club.

POLARIS, pō-lā-ris, *in astronomy*, the bright star at the tip of the tail of Ursa Minor. It is at present less than a degree and a half from the true pole, and by A.D. 2095, through the precession of the equinoxes, it will be under half a degree. Two stars called the pointers (Merak and Dubhe), in the constellation Ursa Major (the Great Bear, commonly called the Plough), always point in the direction of the pole-star, and enable it to be found readily. There is no corresponding star in the southern hemisphere. The pole star is a convenient one for observing to determine the latitude and also the azimuthal error of any transit instrument.

POLARISCOPE, an instrument used for polarizing light and analyzing its properties. See POLARIZATION OF LIGHT.

POLARIZATION OF LIGHT, an effect upon the mode of vibration of light produced by reflection, ordinary refraction or double refraction. The term *polarization* is due to Newton who in the development of his emission theory of light made use of a supposed analogy between the phenomena of magnetism and those observed in optics. The distinction between polarized and unpolarized or as it is sometimes called natural light may be most readily illustrated by means of the phenomena observed when a beam of light is reflected from the surface of a plate of glass or from any other transparent material. At whatever angle a beam may strike the surface a portion will be reflected and the remainder will penetrate the glass following a path the direction of which is determined by the well-known law of ordinary refraction. According to this law *sin i/sin r* = *n*, where *i* (Fig. 1) is the angle of incidence, *r* the angle of refraction and *n* the index of the glass or other material. The reflected ray, although weaker than the incident ray, appears, if we judge it by many of its ordinary properties, to be precisely similar to the latter. It is not, however, in all respects the same, for if it be again reflected from the surface of glass the reflecting power of this second mirror will be found to depend upon its position. If for example both mirrors be so mounted (Fig. 2) that the angle of incidence for each is about 57 degrees and if the second mirror be turned upon an axis so situated as to permit of its rotation without changing the angle of incidence, it will be found that the second mirror reflects the beam received from the first mirror just as it would any ordinary ray so long as its position is such as not to divert the beam from the plane in which it is first reflected. When, however, in consequence of the rotation, the plane of reflection at the second mirror deviates from that at the first mirror, the proportion of light reflected diminishes. When the angle between these two planes becomes 90 degrees no light is reflected from the surface of the second mirror. This striking phenomenon was first noticed by Malus in 1811.

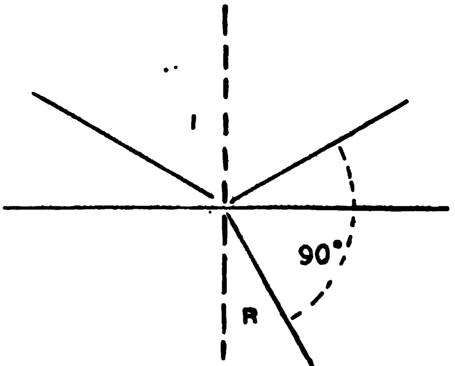


FIG. 1.—The angle of complete polarization.

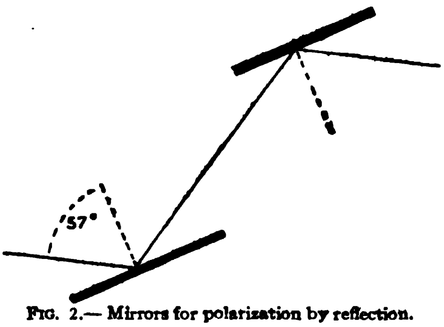


FIG. 2.— Mirrors for polarization by reflection.

It is clear that the beam of light, as the result of the first reflection, has undergone some modification which renders it incapable of being reflected the second time under the conditions just stated. Light thus modified by reflection is said to be polarized.

In accordance with the accepted theory, light consists of exceedingly rapid transverse vibrations of the luminous ether. These transverse vibrations, the progressive motion resulting from which constitutes the light-wave, are supposed to be rectilinear. When, however, in the case of a beam of unpolarized light, we attempt to determine the plane in which the vibrations take place we find that they appear to occur equally in all planes at right angles to the axis of the wave. This is, indeed, the quality which is expressed by the term *unpolarized* light. This is not strange, however, when we consider that in one second of time about *500 million million* vibrations of the ether have taken place. It is supposed that the plane of vibration gradually shifts so that, in the relatively very long interval of time necessary to produce an effect upon the eye, vibrations will have taken place in every possible plane to an equal extent.

That this shifting of the plane of vibration of light is really very slow appears from the ingenious experiments of Lummer and Gehrcke (*Deutsche Physikalische Gesellschaft*, 1902), who have shown that there is no appreciable shifting of the plane of vibration during an interval of time sufficient to allow of at least 2,600,000 vibrations of the ether. Better to grasp these relations, imagine a vibratory movement with a period of one second. More than 2,000,000 years would then elapse before the number of vibrations would equal that executed in the vibration which causes light in a single second of time. In the case of this slow vibration we should expect to be able to detect a slight change in the plane in which the vibrations take place after about four days. Even with this very gradual shifting of the plane of vibration, however, it is obvious that in the course of 2,000,000 years the opportunities for variation are so great that one would not any longer be able to determine what the original plane of vibration had been.

We may for convenience in considering the effect of reflection on a beam of light regard it as made up of two sets of rectilinear vibrations, equal and at right angles to each other; and that one of these sets of vibrations is in the plane of incidence. When the ray reaches the surface of the glass obliquely the component which is vibrating at right angles to the plane of incidence will have its motion parallel to the surface, while the other vibration will penetrate the surface of the glass. One of these will pass on into the glass while the other will be reflected. The result of reflection, therefore, will be to separate the beam of unpolarized light into two parts and the reflected ray will vibrate in a single fixed plane. Light modified in this way is said to be *plane polarized*. The complete separation of the two components by reflection occurs only at a certain angle of incidence, called the *angle of polarization*. Brewster ('Philos. Transactions,' 1815) discovered that this angle varied with different substances and that tan *a* = *n*, where *a* is the angle of polarization and *n* is the index of refraction. This relation is fulfilled whenever in a given case the refracted ray makes an angle of 90 degrees with the reflected ray (see Fig. 1). When the polarized beam reaches the second mirror it will be freely reflected provided the planes of incidence of the two mirrors coincide. When the second mirror is turned so that these planes are at right angles, the ray will penetrate the glass without reflection.

When the theory of light was first developed at the hands of Fresnel, Neumann and numerous other mathematicians, it seemed difficult to determine positively which component of the unpolarized incident ray at the first reflection would be transmitted and which would be reflected. It became customary, therefore, to speak of the plane of polarization rather than of the plane of vibration of the polarized ray; leaving it undetermined whether polarized light vibrated in the plane of polarization or at right angles to the same. The plane of polarization is defined as the plane of incidence. According to the assumptions made by Fresnel, the plane of vibration is perpendicular to the plane of polarization so that it is the component of the incident ray whose vibrations are parallel to the glass, which is reflected.

Some remarkable experiments which afford direct experimental evidence concerning the plane of vibration of polarized light were made by Wiener in 1890 (Wiedemann's 'Annalen,' Vol. 40, page 203). Wiener was able to locate by photographic means the position of the nodes of a standing system of light-waves produced by the interference within a collodion film on glass of the incident and the reflected ray. His interpretation of the results led him to the conclusion that the plane of vibration of polarized light is, as Fresnel had assumed, perpendicular to the plane of polarization.

Polarization by Double Refraction.—Another method by which it is possible to separate a beam of unpolarized light into two polarized components consists in causing the beam to pass through a doubly refracting medium. Many crystals have a structure such that the velocity at which light-waves are transmitted by them depends upon the plane of vibration. A beam of light entering such a crystal is in general resolved into two components, one of which vibrates in the direction which will permit the light to travel with the maximum velocity, the other at right angles to the same. These two polarized beams travel through the crystal independently, the latter being more retarded than the former. If the light enters the crystal obliquely the index of refraction for the two components will differ. The component (*O*) which is most retarded will be more bent from its original path than the other (*E*) and will take a somewhat different direction through the crystal (see Fig. 3). If the two polarized beams thus produced by the action of the crystal leave the crystal through a face parallel to that at which they entered, both will be restored to their original direction and instead of one beam of unpolarized light we then have two beams traveling along parallel paths. The distance between them will depend upon the thickness of the crystal, the angle of incidence and the extent to which the crystal is doubly refracting. If, for example, in the path of a beam of unpolarized light a diaphragm with a circular opening be placed and between this and a screen a lens be mounted in such a position as to produce an image of the diaphragm upon the screen we shall have a circular spot of light at that point on the screen where the image falls. If now in the path of the ray we interpose a rhomb of calcite (Iceland spar) the surfaces of which form an oblique angle with the path of the ray, the latter upon entering the crystal will be bent from its course and divided into two as already described. These upon reaching the screen will form two images of the diaphragm. One of these polarized rays is spoken of as the *ordinary* and the other as the *extraordinary* ray.

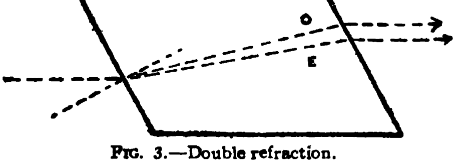


FIG. 3.—Double refraction.

To obtain a single beam of polarized light by means of the action of a doubly refracting crystal it is only necessary to interpose a screen which will intercept one and not the other of the two polarized components, or what is more convenient, to devise some way of intercepting one of these rays within the crystal itself. The device usually employed for this purpose was invented by Nicol (1828). The so-called Nicol prism consists of a rhomb of calcite of the form shown in Fig. 4. The rhomb is cut through diagonally at *CD* and is then cemented together by means of a layer of Canada balsam. The extraordinary ray meets the interface thus produced at an angle which permits its passage while the ordinary ray which is more bent from its course is totally reflected at *O* and passes out through the side of the prism. In this way a single ray of polarized light the plane of polarization of which is known is obtained. This method of producing polarization has the advantage over the method of reflection that the intensity of the polarized light is nearly half of that of the unpolarized ray. The intensity would be exactly 50 per cent but for the slight losses by reflection at the surfaces and by the absorption within the crystal. Various modifications of the Nicol prism have since been devised by Foucault, Glan, Thompson and others.

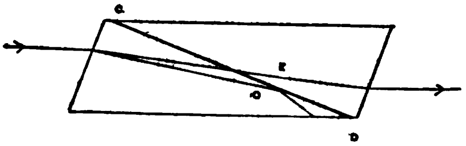


FIG. 4.—Diagram of the Nicol prism.

By means of certain doubly refracting crystals, of which tourmalin is the best example, it is possible to obtain a single plane polarized ray of light without recourse to any artificial device for the separation of the two rays. Such crystals possess the property of absorbing one of the polarized components much more strongly than the other, so that when light is seen through a layer of moderate thickness a considerable percentage of one of the components is transmitted while the other component is completely absorbed.

The use of tourmalin has the disadvantage that the intensity of the transmitted ray is greatly reduced and that owing to the selective character of the absorption within the crystal the composition of the light is greatly modified. Thus white light transmitted by tourmalin is changed by the almost complete absorption of the blue and violet rays to a yellowish green color.

Polariscopes.—An instrument by means of which the investigation of the properties of polarized light and of the numerous effects obtained with the same is carried on is called a *polariscope*. In its simplest form this instrument consists of two parts. The function of the first, which is called the *polarizer*, is to produce plane polarized light; that of the second to enable one to determine the direction of the plane of polarization of the ray thus produced. This part is called the *analyser*. The most convenient form of polariscope for many purposes consists of two Nicol prisms *P* and *A*, Fig. 5, mounted in a common axis, each of which is capable of rotation about this axis. The position of the polarizing plane of each of these prisms is indicated by means of a pointer *V* attached to the prism and moved as the prism is turned around a graduated circle. The polarized ray produced by the passage of light through the first Nicol prism enters the second where it is separated into two components, one of which, the extraordinary, is polarized in the polarizing plane of this prism, while the other is polarized at right angles to that plane. The intensity of these components depends upon the angle which its polarizing plane makes with the polarizing plane of the first Nicol prism. When these two polarizing planes are parallel the *ordinary* component in the second prism becomes equal to zero and the whole of the polarized ray is transmitted, subject only to losses by reflection. As the angle between the polarizing planes of the two prisms increases, the intensity of the extraordinary or transmitted rays falls off and that of the ordinary ray increases until, when this angle reaches 90 degrees, the intensity of the extraordinary ray is reduced to zero and no light is transmitted. Whatever be the angle between the polarizing planes of the two prisms the intensity of the ray transmitted by the analyzer is proportional to $I \cos^2 a$ where I is the intensity of the incident ray and a is the angle between the polarizing planes. When the angle is 90 degrees, so that no light is transmitted, the prisms are said to be *crossed*.

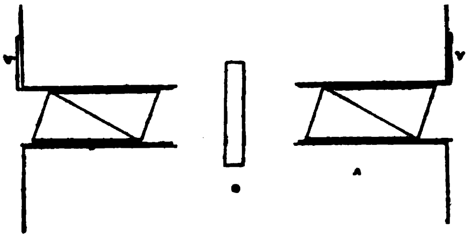


Fig. 5.—Essential parts of a simple polariscope.

When between the polarizer (*P*) and analyzer (*A*) of a polariscope (Fig. 5), with prisms crossed, a layer (*C*) of any transparent doubly refracting crystal is placed there is restoration of light. Although as already explained the polarized beam from the first prism was unable to pass through the second, the insertion of the crystal between the two prisms has enabled it to do so. The explanation of this beautiful phenomenon is as follows:

The beam of plane polarized light from the first Nicol, which we may suppose to be vibrating in a vertical plane, enters a medium when it reaches the crystal, in which in general light vibrating in two oblique positions at right angles to each other, and in those positions only, is transmitted. The beam then is resolved into two components having these oblique directions of vibration. The light which reaches the analyzer after passing through the layer of crystal is vibrating in these two oblique planes each of which has a horizontal component which is capable of passing through the prism. Not the whole of the light from the polarizer is transmitted by the analyzer, the vertical component of each of the oblique rays being suppressed.

A great variety of crystalline substances, such as quartz, mica, selenite, calcite and indeed all doubly refracting substances, are capable of producing this effect. If the crystalline layer be of proper thickness not only do we have transmission of light but likewise a change of white light into light of other colors produced by the interference of the two components after passage through the second prism. This production of colors by means of a polariscope is one of the most striking phenomena known in optics. The two polarized rays in the crystal, the ordinary and the extraordinary rays, move with different velocities. We have, therefore, emerging from the crystal two similar rays, one of which is somewhat behind the other on account of its greater retardation and which consequently differs from it in phase. So long as these rays have planes of vibration at right angles to one another they cannot interfere, but in the second prism those portions of each which are transmitted are vibrating in the same plane and interference becomes possible. The result of this interference is the destruction of certain of the wave-lengths of which the light is made up. If the incident beam consist of white light that emerging from the analyzer will be white minus the particular constituent or color which has been destroyed by the interference and the beam will have a color other than white. The character of the color of the ray will depend upon the thickness of the crystal layer since it is this which determines the degree of relative retardation of the two components passing through it. If the thickness of the crystal be everywhere the same, the color produced in different parts of it will be uniform, but difference in thickness gives change of color so that the field of view is in many instances most varied and striking.

The effects produced by passing a beam of convergent or divergent light through crystals are still more striking. If plates of crystalline material, placed between the prisms of a polariscope which is provided with a lens for the production of a conical beam of light, are viewed through the analyzer, symmetrical patterns in color the form of which depends upon the character of the crystal and the plane, with reference to its axis, in which the layer has been cut, are seen. Any detailed description or explanation of these phenomena lies beyond the scope of this article, nor can any idea of the beauty and intricacy of the color-patterns thus produced be conveyed to the mind by words.

Isotropic substances, such as glass, show temporary double refraction, which manifests itself by restoration of light and display of colors between crossed Nicols, when subjected to distortion or stress. Such effects in glass, for example, are produced by compression under a clamp, by bending or twisting, by sudden unequal heating or cooling, or even by setting up standing sound-waves within the substance. Permanent strains, which show themselves in the same way, may be formed in glass by sudden chilling. Blocks of glass thus treated, and known, in French, as *verre trempé*, are among the most beautiful of objects under the polariscope.

Circular and Elliptical Polarization.— When the vibratory motion to which a beam of light is due is capable of being resolved into two components at right angles to each other, of equal amplitude, and differing in phase by a quarter period, the beam is said to be *circularly polarized*.

The actual motion of the ether particles in such a case, could we observe it, would be found to consist of rotation in a circular orbit, either clock-wise or counter clock-wise (looking in the direction from which the wave comes) hence the names, *right-handed circular polarisation* and *left-handed circular polarization*.

Circular polarization may be produced by sending light through a crystalline layer of such thickness that the difference of phase of the two rays on emerging is π 2 (a quarter period). Such a layer is caller a *quarter-wave plate*.

When the difference of phase of the two components differs from π 2 the emerging beam is said to be elliptically polarized.

Rotation of the Plane of Polarization.— Certain substances have the property of rotating the plane of polarized light which passes through them. Quartz cut perpendicularly to the optic axis possesses this property to a remarkable degree, and many organic liquids possess rotatory power. Such substances are said to be *optically active*. A plane polarized ray upon entering such a medium is converted into two circularly polarized rays, respectively right-handed and left-handed. The resultant of the superposition of these two rays is a plane polarized ray the plane of polarization of which varies with the depth within the layer at which the angle is taken. We may, therefore, think of the plane of polarization as rotating uniformly about the path of the ray.

The rotatory power of solutions of optically active substances depends upon the strength of the solution and this fact has been utilized, in the case of sugar, for determining the amount of saccharine matter present. The instruments employed in this process are special forms of polariscope of great sensitiveness. They are known as *saccharimeters*.

Magnetically Active Substances.— When a beam of plane polarized light passes through a magnetic field in the direction of the lines of force, the plane of polarization is turned.

Looking along the lines of force in the direction in which, by convention, they are assumed to run, the rotation is always clockwise to the observer, whether the light travels with or against the lines. The angle of rotation is proportional to the strength of the field, and to the distance through which the light passes. It depends also upon the medium through which the light moves; being nearly four times as great in carbon-disulphide than in water and more than five times as great in glass as in water. These relations may be expressed by means of the equation $a = \gamma lH$; where a is the angle of rotation, l the distance traversed, H the strength of the field and γ a constant (known as Verdet's constant) which depends upon the character of the medium.

This rotatory power of the magnetic field was discovered by Faraday (1845). To observe it a tube containing carbon-disulphide or water (Fig. 6) is placed between crossed Nicol prisms.

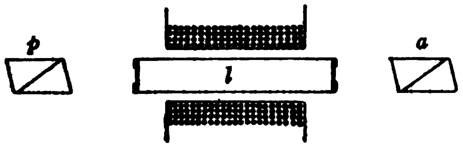


FIG. 6.—Rotation in the magnetic field.

The tube is surrounded by a coil of wire of many turns.

A beam of light is plane polarized by the prism (*p*), traverses the tube of liquid (*l*), but cannot pass *a*, the polarizing plane of which is at right angles to that of *p*.

When a strong current is sent through the coil, lines of force of the magnetic field thus produced traverse the tube from end to end. Some light now passes through *a* and the angle of rotation may be measured by turning that prism until the light is again cut off. Upon reversing the current in the coil the direction of rotation is reversed.

Bibliography.— For popular discussions consult Spottiswoode, 'Polarisation of Light'; Tyndall, 'On Light'; Stokes, 'On Light'; Tait, 'On Light'; Wright, Lewis, 'On Light,' etc. For a very complete modern statement of the theory see Drude, 'Theory of Light' (translated by Mann and Millikan). See LIGHT; PHYSICAL CRYSTALLOGRAPHY.

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POLARIZED HEAT. Radiant heat and light are found to be analogous in their reflection, refraction and absorption. See RADIATION.

POLARIZED LIGHT. See POLARIZATION OF LIGHT.

POLDER, pōl'dėr, a name used in Holland and Belgium for a class of agricultural lands consisting of extensive tracts reclaimed by drainage from what had originally consisted of lakes or morasses, and generally lying below the level of the sea. The transformation of the Lake of Haarlem is a striking illustration of what can be effected through energy and patient perseverance. The usual method of procedure in the formation of a polder is to encircle the portion to be reclaimed by an embankment, and construct a canal having its bed sufficiently high to cause a current toward the sea or river. The water is then pumped into this canal by means of various pumping apparatus, worked for the most part by means of wind-mills, but not unfrequently by steam power. After the water has been drained off, the land is put into the hands of the husbandman, and this kind of soil is in general found to be very productive.

POLE, Reginald, English Roman Catholic prelate: b. Stourton Castle, Staffordshire, 3 March 1500; d. London 17 Nov. 1558. He was the son of Sir Richard Pole, Lord Montacute, by Margaret, daughter of the Duke of Clarence, brother of Edward IV. He was educated at Oxford, where Linacre and Latimer were among his teachers, entered into deacon's orders and received several benefices from Henry VIII, with whom he was a great favorite. In 1519 he visited Italy, and at Padua acquired the friendship of such men as Erasmus, Bembo and Sadoleto. He returned to England in 1525, but in consequence of the affair of Henry's divorce from Catherine of Aragon, withdrew to Paris (1529), under the pretext of continuing there his theological studies. In 1536, in compliance with Henry's order that he should give his opinion regarding the divorce, he drew up an elaborate epistle, 'Pro Ecclesiasticæ Unitatis Defensione,' in which he boldly condemned the divorce as unlawful, and the rejection of the papal supremacy as a breach made in the unity of the Church. This act cost him the loss of all his preferment in England, and he endeavored to form a party against Henry, a design which ended in the destruction of his brother, Lord Montacute, and his aged mother, the Countess of Salisbury, whom Henry sent to the scaffold. Pole was declared a traitor by the king, a price was set on his head and he lived in exile during the rest of Henry's reign. But papal support was given to him, and he was raised to the dignity of cardinal and employed on some important missions. He was one of the three papal legates to the Council of Trent; and on the death of Pope Paul III, Pole came but little short of election as his successor. On the accession of Mary I his attainder was reversed, and in 1554 he returned to England as legate and plenipotentiary of the papal see, and endeavored to secure lenient measures for the reformers and correction of clerical abuses. On the death of Cranmer, Pole, then for the first time ordained a priest, became archbishop of Canterbury, and was at the same time elected chancellor of the universities of Oxford and Cambridge. He undertook to rebuild the churches and to re-establish the ancient discipline, and to a rigorous persecution of Protestants which was instituted he at least assented. His death occurred on the same day as that of Queen Mary, and he was buried in Canterbury Cathedral. Besides several treatises on questions relating to the Church, he wrote 'Liber de Concilio'; 'De Summo Pontifice Christi in Terræ Vicaris,' and 'A Treatise on Justification.' Consult Gairdner, J., 'The English Church in the 16th Century' (London 1903); Haile, M., 'Life of Reginald Pole' (New York 1910); Lee, F. G., 'Reginald Pole' (London 1888); Phillips, T., 'History of the Life of Reginald Pole' (2 vols., Oxford 1764); Zimmerman, A., 'Kardinal Pole: sein Leben . . .' (Regensburg 1893).

POLE, William, English playwright: b. London, 1852. He was manager of Royal Victoria Hall, London, 1881–83, and in 1895 established the Elizabethan Stage Society for the purpose of awakening interest in the Elizabethan drama. Among old plays which he has revived are Webster's 'Duchess of Malfi' (1892); 'Arden of Feversham'; Marlowe's 'Dr. Faustus'; Ford's 'Broken Heart'; Ben Jonson's 'Sad Shepherd' and 'Alchemist'; and 'Everyman.' He has dramatized several novels, among others W. D. Howells's 'Foregone Conclusion' as 'Priest and Painter' (1884), and Baring-Gould's 'Mehalah' (1886).

POLE, (1) *in astronomy,* the name given to each of the two points in which the axis of the earth is supposed to meet the sphere of the heavens. (2) *In spherical trigonometry,* the pole of any circle drawn on the surface of a sphere is one of the points in which the perpendicular to its plane through its centre cuts the sphere. (3) *In geography,* either extremity of the axis around which the earth revolves is called a pole, or a terrestrial pole. The northern one is called the north pole, and the southern the south pole. Each of these poles is 90° distant from every part of the equator. (See EARTH). (4) In *physics,* the points of a body at which its attractive or repulsive energy is concentrated, as the poles of a magnet, the north pole of a needle, the poles of a battery. (5) *In distance,* see PERCH. (6) *In mathematics,* the point from which the radius sector of any point is estimated, in the polar system of co-ordinates.

POLE, Magnetic. See MAGNETISM.

POLE-AXE, an axe attached to a pole or handle of which the length varies considerably. It was formerly used by mounted soldiers, and is yet used in the navy for boarding purposes: in the latter case the back of the axe is furnished with a hook and is called a boat-hook and a boarding-axe.

POLE STAR. See POLARIS.

POLECAT, a small European carnivore (*Mustela putorius*) of the weasel family. It has an elongated body, short legs, long and flexible neck, and blunt muzzle. Its anal glands are large and discharge a fetid liquid of extremely nauseous odor, almost impossible to remove from clothing or any absorbent material upon which it falls. Hence it is known provincially in Great Britain as fou'mart (that is, foul marten), and the term "polecat" has been applied to the American skunk and other stinking animals; "fitch" (or fitchew) is another name. The general habits are those of the fur-bearing animals (*Mustelidæ*) generally, with a special predilection for preying on poultry and game. A domesticated variety is the ferret (q.v.).

POLEMON, pŏl'ę-mŏn, surnamed *Periegetes,* Greek geographer: b. Troas, 2d century B.C. He removed to Athens, became a citizen there, and after traveling extensively throughout Greece wrote several geographical works which were especially valuable in that they contained definite information concerning public monuments, inscriptions, paintings, etc., which had hitherto remained unnoticed by geographers. He wrote several polemical works against Timæus and Eratosthenes, and references to his writings are frequently made by later writers, including Athenæus and Pausanias. A list of his works, 26 in number, on both geographical and historical subjects, is given by Clinton in his ‘Fasti Hellenici,’ iii, 514, but none of these have come down to us entire. The few remaining fragments of his works were collected and published by Preller (1838). Polemon is considered the father of geographical guide books.

POLEMOSCOPE, a stand or frame high enough to rise above a parapet or other similar object, having a plane mirror at top so fitted as to reflect any scene upon another mirror below, and thus enable a person to see a scene in which he is interested without exposing himself. It is of somewhat ancient origin, but the principle has had a modern application to opera glasses and field glass, and, particularly, to the periscope used on submarines in the World War.

POLENTA, a food preparation common in Italy, consisting of semolina or Indian-corn meal, mixed with water, and boiled until it thickens. It is then poured into a dish, where it becomes firm enough to be cut into slices, in which state, after being seasoned, it is eaten.

POLENZ, pōl'ĕnts, **Wilhelm von,** German novelist: b. at Castle Oberkunewalde, Oberlausitz, Saxony, 14 Jan. 1861; d. there, 13 Nov. 1903. Studying at the universities of Leipzig and Berlin he fell under the spell of modern ideas. In 1891 he published his first novel ‘Sühne’ which was followed by a drama, ‘Heinrich von Kleist’ (1891).

His three greatest works are, ‘Der Pfarrer von Breitendorf,’ (1893); ‘Der Büttnerbauer’ (1895); and ‘Der Grabenhäger’ (1897). In this trilogy the three several influential personalities in the German country community are described — the pastor, the independent farmer, and the lord of the manor. In the first we find the life of a pastor whose inner spiritual nature develops away from outer churchgoing forms, so that he is finally prompted to give up his parish. In the second novel the life of an older type of unprogressive farmer is depicted, whose possessions fall into the hands of usurers and when the situation becomes unbearable, he commits suicide. In the third book the life of a *Junker* is described, who after tasting the pleasures of life in a large city, returns to his ancestral estate and there learns the serious duties and responsibilities of a rich landowner. Among his numerous other writings are the novels ‘Thekla Lüdekind’ (1900) in which Polenz in an indirect manner deals with the woman question; ‘Liebe ist Ewig’ (1901); ‘Wurzellocker’ (1902); ‘Lugisland’ (1901) is a series of short stories. In 1902 Polenz made a visit to the United States. His impressions of this trip he has given in his book, ‘Das Land der Zukunft’ (1903). He coined the phrase, “*Das Land der unbegrenzten Möglichkeiten.*” “The land of unlimited possibilities,” as applied to America. After his death his brother published a collection of poems from his posthumous papers under the title, ‘Erntezeit’ (1904). Consult Bartels, A., ‘Introduction to the Collected Works of Wilhelm von Polenz’; von Mach, Edmund, ‘The German Classics’ (Vol. XVII, New York 1914); Stern, ‘Studien zur Literatur der Gegenwart’ (Dresden 1904, pp. 235–253).

POLHEM, pōl'hĕm, **Chistopher,** Swedish engineer: b. Visby, 1661; d. 1751. He was educated at Upsala. Polhem invented a machine for hoisting ore, which proved so successful that the inventor was made director of mine mechanics by the king. In 1694–97 Polhem traveled in England, France, Germany and Holland, everywhere taking special note of all mechanical inventions and improvements. He subsequently invented quite a number of machines for agriculture, mining and transportation and from Charles XII received the commission to construct a canal between the Baltic and the Cattegat. He also invented a minting machine for George I of England and was knighted by his own sovereign.

POLICE, pō'lēs (Greek, *politeia,* government, from *polis,* a city), a judicial and executive system, and an organized civil force for maintaining order and enforcing the laws. There are traces to be found in every organized society of some system of rules for the maintenance of peace and order. At the same time, a system of police in the special modern sense of the term did not exist in ancient times. In Greece it was mixed up with the totality of their institutions. In Rome, not until the time of Augustus do we find the police becoming a special institution, with a numerous staff of various grades of officers. When the barbarians swept across the Roman Empire and obtained the mastery every trace of a regular system of police disappeared, and only when Charlemagne ascended the throne was there a successful attempt made to re-establish anything of the kind. But after the death of Charlemagne everything fell into confusion again. The Normans, established in the north of France, were the first who made stringent police regulations for the assurance of public tranquillity. In France, previous to the middle of the 15th century, the provost of Paris and his lieutenants were charged with maintaining the peace of the city and suppressing vagrancy. Under Louis XIV the police attained its highest measure of perfection as a repressive force. A universal system of espionage was established, and the slightest indication of impatience under the yoke of oppression, or the smallest departure from the monarch's views of what was right, was visited with summary arrest and punishment. In 1794 the National Convention reorganized the police and defined its duties, which comprised almost every department of administrative government. During the administration of Napoleon I the city police of Paris attained a high degree of efficiency. As existing at present the French police generally is presided over by the Minister of the Interior; the departments and communes are under the prefects of police and other municipal agents; Paris is under sub-prefects, and maires, assisted by commissaries, the prefect of police and his numerous assistants. The police organization on the Continent generally partakes largely of a military character.

In England, from the time of the Saxon kings there had existed an organization of a partially voluntary character for the repression of crime, the arrest of criminals and the maintenance of good order. The population was divided into hundreds and these into tithings, or companies of 10 freeholders with their families. As this system, however, was not always found to work well, the high sheriff of the county, his deputies and the constables appointed by the parishes were eventually substituted for the voluntary officers of the earlier period. But in process of time this system was also found ineffectual for the maintenance of public peace and security; yet no great improvement was made until 1829, when the remodeling of the police system of London led the way to the adoption of a uniform system for the whole country. In 1839 and 1840 acts were passed providing for the appointment of a county constabulary, organized and maintained in accordance with rules prescribed by the home secretary.

The Local Government Act of 1888 entrusted the control of the organization of the county police in England and Wales to the standing joint committee of the quarter sessions and the county council. County boroughs and other large boroughs were left with the control of their police, but in the case of small boroughs the control of the borough police was transferred to the county council. The Police Act of 1890 makes provision for the payment of pensions to superannuated constables. Gratuities may be paid to constables or to their widows and children in certain cases. The strength of the county and borough police of England and Wales in 1900 was 27,123, of whom 1,460 belonged to Liverpool, 1,000 to Manchester, 700 to Birmingham, 500 to Leeds, 499 to Bristol and 465 to Sheffield. The Metropolitan Police has charge of an area of over 688 square miles, comprising 21 land divisions besides the river Thames. Each division is under the charge of a superintendent. The Criminal Investigation Department, organized in 1878, comprises a central body at New Scotland Yard and branches in each of the divisions. The Convict Supervision Office, founded in 1880, is a branch of the last-mentioned department. The strength of the Metropolitan Police in 1916 was 22,323, comprising 36 superintendents, 650 inspectors, 2,995 sergeants and 18,642 constables. The City of London Police are better paid than the other police forces of the kingdom. Their number in 1916 was 1,161, of whom 1,015 were constables.

In Scotland the organization of an efficient police in the large towns dates from 1833, when a statute was passed enabling burghs to establish a general system of police. The strength of the Scottish police forces was 5,952 in 1916, of whom 2,100 belonged to county forces and 3,852 to city and burgh forces.

In Ireland, previous to 1814, the police was in a very disordered condition. In that year a law was passed by which some minor improvements were effected. The act of 1836 and its subsequent modifications in 1848 and 1857 have greatly improved the police. In 1867 the title of Royal Irish Constabulary was conferred on the force by royal command. This force in 1916 numbered 9,860 and was organized on a semi-military plan. They live in barracks and are armed with rifles, swords and other weapons. They are under the immediate authority of the government in Ireland, and are controlled by an inspector-general. The city of Dublin and its suburbs, with an area of 32 square miles, is under a separate police force, known as the Dublin Metropolitan Police. The strength of the force in 1916 was 1,143.

In the United States the provisions for the repression of crime and the detection and arrest of criminals were copied from those of Great Britain. New York was the first of the cities to have a police force organized similarly to that previously adopted in London. The ordinary police of a city are dressed in a particular uniform. The secret police, more commonly known as detectives, are not uniformed. The regulation and control of the police in a city is usually in the hands of the municipal authorities, and the cost of their maintenance is paid out of the local taxes. In New York City a division of the force is known as harbor police, and there are police boats for their convenience in patrolling the harbor. In Washington there exists a special force known as capitol police, employed by the government to patrol the buildings and grounds of the National Capitol. In most large cities there are squads of sanitary police and in some smaller towns volunteer bodies of citizens are organized under the name of fire-police. The secret police of the United States government are known as secret service agents.

Military police constitute an organized and uniformed body of men attached to the army for the maintenance of civil order, as distinguished from military discipline. After the United States was forced into the World War a number of large cities organized women police to look after minor infractions of law, and also a body of reserve police to aid in repressing outbreaks, because of the shortage of the regular police who had entered the army. The varied functions of the police in the United States are specifically set forth in State and municipal enactments. In brief, it may be stated that if the police of a municipality are unable to cope with a disturbance the sheriff of the county may be called on for aid; if the sheriff cannot suppress a trouble, after he has read aloud the riot act, ordered a mob to disperse and summoned civilians to his aid, he may appeal to the governor of the State for a military force; and should the latter prove ineffectual, the governor may call upon the Secretary of War for reinforcements from the regular army. See SECRET SERVICE; also CONSTABLE; DETECTIVE.

POLICE, Military. See MILITARY POLICE.

POLICE COURT. See COURT.

POLICE AND FIRE ALARM SYSTEMS. The usual police alarm system consists of a bell signal and telephone arranged in boxes at desired locations. Keys to these boxes are held by the policemen on duty, who must report at certain times from these boxes to headquarters by telephone. On the other hand, if headquarters desires to get in touch with the policeman on a certain post, a bell is rung, attracting the party called. This system is, however, not satisfactory, inasmuch as in most cases the sound of the bell, confused with so many other noises of the city, is not heard. Due to the need for something better, within the past few years a combination involving also a visible signal has been installed in various cities, particularly those of Germany, where an elaborate system is to be found. Under this system, which is worked out in detail, the principal feature is a green signal lamp that flashes when the policeman on post is wanted.

Closely analogous with the German police-alarm system is the fire-alarm system in general use throughout continental Europe, the chief difference being that the signal lamps are red instead of green. The advantage of the alarm box and telephone to fire headquarters is apparent, in that it permits the department to know immediately and exactly the location of the fire. It is of advantage, however, as is the practice in many places, to dispense with the use of the key to open the box and using a push-button or other handy device instead, for the sake of saving time.

The fire-alarm lamps are, as a rule, about 15 feet above the sidewalk, while the alarm boxes are attached to the fire-alarm posts within easy reach, some four feet, of pedestrians. These boxes are generally provided with a handle or crank, which must be pulled or turned according to directions.

Under the ordinary system it is not unusual for the individual fire alarm to be sent into the central fire headquarters, and from there transmitted to the branch headquarters, with a consequent loss of time. Under the system under description this is avoided, notice of each fire being sent to the nearest fire house and simultaneously to the main or central headquarters.

A fire-alarm system based on the above principles has been installed in the city of Berlin, where the fire apparatus is also operated by electricity. According to the United States Consular Reports of 9 Aug. 1911, «it takes but 12 seconds from the time an alarm is sounded until the department is fully under way on the street.»

The great extent of the fire losses throughout the country is rarely understood by the public. Yet, in the failure to take ordinary precautions against fire, and in carelessness and faulty construction, losses amounting to $750,000 per day are incurred throughout the United States. On the other hand, the fire losses abroad for six principal cities for a period of five years averaged 33 cents per person, as compared with losses of $3.02 per capita in the United States. It will, therefore, be seen that American cities are in need of adopting the most urgent measures and of installing up-to-date and efficient methods of fire and police alarm. The necessity is most apparent and will be recognized by all when it is remembered that the cost of adequate protection is but a small percentage of the yearly damage done by fire in each city.

POLICE JUSTICES. See Court.

POLICE MAGISTRATES. See Court.

POLICE POWER. No adequate definition can be given of this subject, the courts usually deciding in each case as to its extent. In its general acceptation it means the power of a municipal government to preserve the welfare of the public by prohibiting everything that is contrary to it, and demanding that which is best for its welfare and safety. The proper exercise of police power is merely to regulate the use and enjoyment of property by its owner; it is founded upon the duty of the State to aid in the protection of its citizens. Legislatures have jurisdiction of police power through a federal system of government, and it is delegated by the State to the municipalities throughout the State, and is exercisable only within its limits. Standard laws and the preservation of the public health are one of the most important duties of the police or State municipality, and they have the right to enact such ordinances as may be required for this purpose — such, for example, as preventing the spread of contagious diseases, and, in some instances, compelling vaccination, the killing of diseased cattle, the destruction of improper food products, compelling proper drainage, prohibiting smoking and expectorating where necessary and the regulation of burials. An important function of the police power is to provide safety for the public in regulating places of public amusement and meetings; compelling the erection of fire-escapes, providing for street lighting and to protect the public morals by prohibiting gambling, improper publications, cruelty to animals, prostitution and drunkenness. The municipalities' general welfare is another important function, for example: protection against fire, regulation of buildings and the erection of telephone and telegraph wires, the care of the insane and poor, abatement of nuisances of all kinds and regulation and control of animals. The regulation of certain classes of business enterprises come within police power, for example: theatres, markets, paint shops, warehouses and wharves, or any such business that if unrestricted may become injurious to the public welfare. Police power regulates the practice of law, medicine, surgery, also plumbers and the business of insurance, banking, trust and railroad companies; it is also within their power to regulate the manufacture and sale of articles of food, the prevention of fraud and the hours of labor. The proper limitation of the police power is largely within the discretion of the legislature, but the reasonableness and character of the regulations and whether or not they are consistent with the constitution and proper public policy, are questions for the courts to decide. Police power cannot be exercised for the benefit of particular individuals, classes or for private purposes; it must not be arbitrary or unreasonable in infringing upon the personal rights of persons, and its main object must be for the public good. See Police.

POLICY, the name given a lottery or gambling system, common in large cities. A combination of numbers like 4-11-44 is selected by the player who marks his numbers or «guesses» on a slip or ticket, for which he pays a small sum. The lottery drawing of three numbers awards prizes to those persons having guessed correctly. A favorite or common combination of numbers is called a «gig.» The person playing policy stands only a very small chance of winning a prize.

POLICY, Insurance. See Insurance.

POLIDORO (Caldara) de Caravaggio. See Caravaggio da Polidoro.

POLIGNAC, pō-lēn-yăk, **Jules Auguste Armand Marie**, Prince de, French statesman: b. Versailles, France, 14 May 1780; d. Saint Germain, France, 2 March 1847. He was implicated in a conspiracy against Napoleon in 1804, and imprisoned, but in 1814 escaped to Edinburgh, where the Comte d'Artois, afterward Charles X, then was. After the restoration he entered the chamber of peers and in 1820 obtained from the Pope, as a reward for services to the Church, the title and arms of a Roman prince. In 1823 he succeeded Chateaubriand as Ambassador at London; and in 1829 was placed at the head of the new ministry, with the portfolio of foreign affairs. On 27 July 1830 the people were roused to open insurrection by the ordonnances issued on the 25th, and the dynasty of Charles X was overthrown. Polignac accompanied the king to Cherbourg, and then went to Granville, where he was apprehended. The house of peers condemned him to imprisonment for life, but by the amnesty of 1836 he recovered his liberty and fixed his residence in England.

POLIGNAC, Melchior De, French cardinal and diplomat: b. Puy-en-Velay, Haute-Loire, France, 1661; d. 10 Nov. 1741. He was educated for the priesthood and in 1693 was named ambassador extraordinary from France to Poland, for the purpose of detaching John Sobieski from the league with Austria, and drawing him over to an alliance with France. On the death of Sobieski in 1696 he was employed in endeavoring to effect the election of the Prince of Conti to the Polish throne. His intrigues, though successful in securing Conti's election in 1691, were defeated by Augustus the Strong; Polignac was compelled to leave Poland in 1702. He returned to Paris and in 1712 was appointed plenipotentiary to the Congress of Utrecht, and was afterward Minister to the court of Rome. He became cardinal in 1713. Banished during the regency by reason of his intrigues, he was recalled in 1721, and in 1725 was despatched as Ambassador to Rome, successfully performed his task of reconciling the quarreling factions of the Gallican Church and was raised to the archbishopric of Auch. He returned to France in 1732 and thereafter lived in retirement. As a writer Polignac is known by his didactic poem ‹Anti-Lucretius, seu de Deo et Natura,› planned to prove the existence of a Supreme Being, the maker and regulator of all things. The ninth book of this work was left unfinished by the author, and the whole poem was not published till after his death. It was later translated into French and Italian.

POLILLO, pō-lē'lyō, (1) a group of islands of the Philippine archipelago, lying to the north of the entrance of Lamon Bay, southern Luzon, and east of central Luzon. The group consists of the chief island Polillo and 21 small islands, lying to the south and east; area of the island of Polillo, 131 square miles; area of the group, 203 square miles. The formation of the islands is volcanic; the soil is good, and the inhabitants are engaged mostly in agriculture and fishing for home consumption. The island of Polillo is mountainous; the central summit is Malolo, from which short ranges extend in every direction toward the coast. The chief town of the group, Polillo, is situated on the west coast on a bay that affords a good harbor. The group, which was included in the province of Infanta bv the act of the Philippine Commission of June 1902, was afterward annexed to the province of Tayabas. Pop. 2,164.

POLIOMYELITIS. Also known as *Infantile Paralysis*, or *Heine Medins Disease*. An acute infectious disease, chiefly involving the spinal cord and its membranes, at times progressing into the upper parts of the mid-brain and brain itself. The agent itself has not been definitely isolated (1919) although the disease has been communicated to lower animals (chiefly monkeys) and has been transmitted through a number of generations of these animals. It is known that it is a filterable virus of some kind, in some ways behaving like the filterable virus of the disease known as hydrophobia. The mode of ingress is not definitely known, but the naso-pharynx is supposed to carry it. It is a communicable disease and occurs in epidemic form, some epidemics having almost circled the globe. It is chiefly found in temperate zones, and the epidemics have occurred chiefly in the summer or autumn, though winter and spring epidemics are known. It is frequently confused with influenza, epidemic lethargic encephalitis and certain forms of cerebro-spinal meningitis. It affects children chiefly, but not exclusively.

The disease often begins with mild respiratory or gastro-intestinal disturbances. There are vague neuralgic pains and headaches, there may be increased irritability to light, sounds and touch and in from 24 to 72 hours certain groups of muscles are partially or completely paralyzed. These paralyses are usually very unequally distributed, and whole muscle groups or parts of a muscle are involved. The involuntary structures are also at times involved, causing various trophic or vegetative disturbances. The nature of the changes in the spinal cord and meninges are those of an acute infiltrating inflammation in which the blood supply to the cord may be cut off or the inflammatory œdema cause swelling and pressure upon nerve structures. Thus there results a partial or complete destruction of the nerve structures of the spinal cord which are correlated with muscle function. The large cells of the anterior horns of the spinal cord, which are stations in the pathways for the conduction of motor nerve impulses, seem to bear the brunt of the inflammatory changes, and hence present the most obvious changes which were seen in the old cases. But it must be remembered that the pathology which was described in the older accounts was framed upon the study of the old and long since active cases. The modern study has shown the widespread involvement of the nervous system and also shown that the disease may be traced to other than purely nervous structures, even if the latter bear the brunt of the serious left-over destructions. In certain patients the chief destructions are found in the mid-brain tissues; from these result paralyses of the cranial nerves, particularly of the eye-ball muscles and the muscles of the face.

The course of the disease varies considerably. As a rule its worst effects are present within the first week of the illness. After this comes the long and tedious stages of recovery which going on slowly at first may improve more rapidly and then a very long period, years it may be, of very slow and gradual improvement if the proper kind of treatment is pursued.

The treatment is preventive, palliative and restorative. In the preventive treatment great care should be taken not to come in contact with poliomyelitis cases, especially in the early stages.

As some of those sick from the disease may have it in a very light form special quarantine measures are desirable for these suspects. All children taken sick during an epidemic should be carefully isolated and contacts with others made as light as possible. In the acute stages of the disease it is not known what may be beneficial. Lumbar puncture helps some, ergot help others, and specific sera are being evolved which may help others. These sera are constantly being improved and this article can only call attention to this fact and urge the afflicted parents to call upon such wide-awake physicians who would be most likely to be abreast of the times and know what is going on in medicine. In the treatment of the chronic phases great care and detailed attention should be given to conscious muscle training. Electricity, massage and other similar types of therapy are usually unavailing. They are for the most part stupid. The sick and partly degenerated muscles must be activated into tonic action through the only kind of stimulus to which the muscles are physiologically accustomed, namely, the conscious wish to perform movements. This type of therapy requires a detailed knowledge of the use of all of the muscles and the correct type of stimulus to bring out its physiological possibilities. The usual type of gymnastic studies or exercises are as a rule as valueless as the massage and the electricity. Consult Jelliffe and White, 'Diseases of the Nervous System' (3d ed., 1919).

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POLISH FOWL, a breed of domestic fowls. See POULTRY.

POLISH FRANCISCANS IN AMERICA. A religious community of the Franciscan order of Friar Minors established at Pulaski, Wis., in 1887, through the special efforts of the Ven. Augustin Zeytz, O.F.M., at the request of the Very Rev. Joachim Maciejcyk, O.F.M., the provincial of Galicia, Poland. Through the generosity of Mr. J. J. Hof, a grant of 120 acres of land was secured at Pulaski, in the State of Wisconsin, where three Polish settlements had been started, and on 27 April 1887 the cornerstone of the new monastery of the Assumption of the Blessed Virgin was consecrated. The Rev. Erasmus Sobicinski, O.F.M., of Galicia was appointed the first superior. On 8 April 1889 the novitiate was formally opened and the first candidate was received in the order. From this time the institution grew and developed, under successive directors, Father Erasmus, the first superior, having died 4 Feb. 1890. In 1900 a new residence was opened in Green Bay, Wis., where in 1903 a new large convent was built and dedicated. At Pulaski, 9 Sept. 1901, Seraphic College was opened and the building subsequently enlarged to accommodate the ever-growing number of students. The community numbers among its members 14 priests, 31 professed clerics, 30 professed lay brothers, 7 brothers of the Order and 50 students.

POLISH LANGUAGE. The Polish language is one of the Slavic family of tongues and is most nearly related to the Bohemian branch of that family. It belongs to the western group of those languages and is spoken by about 15,000,000 people, in its various dialects. Remarkable for its phonetic richness, Polish contains 10 vowels and 35 consonants. The alphabet is the Latin, diacritic marks and combinations being used in addition. The principal peculiarities of pronunciation are the following: *c* is pronounced like *ts* in English; *ch* is a strong guttural, as in German; *cz* is pronounced like *ch* in English; *rz* has a sound compounded of that of *r* and the sound of *z* in the word azure, sometimes almost the same as the latter sound alone; *sz* is pronounced like our *sh*; *w* has the sound of *v*. The consonant *ć* has a sound absolutely peculiar to the Polish language: it resembles that of *t* followed by or combined with a very soft *sh*. The barred *l* (*ł*) has a sound common to the Polish with other Slavic tongues: it is produced by sounding the letter *l* with the point of the tongue firmly pressed against the teeth. The result is a sound approaching that of *w*. as the *l* in *talk*. Among the vowels *e* and *a* are pronounced respectively like the French semi-nasals *in* and *on*; *i* has the sound of *i* in the English word pique; and *y* has a sound resembling that of the German *ü*. The tonic accent in Polish words is nearly always on the penult.

The Polish is a highly inflected language. There were formerly three numbers, but the dual has been preserved only in the Masovian dialect. There are three genders, masculine, feminine and neuter; and seven cases, the nominative, genitive, dative, accusative, vocative, instrumental and locative or prepositional. The diminutives and augmentatives are numerous. The inflections of the verbs indicate not only person and number without the aid of personal pronouns as in Russian, but also the gender of the person speaking, and the person spoken about. The great variety of inflections in Polish permits the extensive use of inversion in the structure of sentences.

The principal dialects of Polish are the Masovian or Mazurian, spoken in the districts around Warsaw and in east Prussia; that of Great Poland, which is spoken chiefly in the districts around Posen, Gnesen and Kalisz; the Silesian spoken to the east of the Oder; the Cracovian or the dialect of Little Poland; and the Polish-Lithuanian as distinguished from the Lithuanian proper the language of some of the greatest Polish writers. Consult Polish dictionaries by Booch-Arkossy, F. (Polish-German, 2 vols., Leipzig 1893 and 1899); Chodzko, A. E. B. (Polish-English 1884); Dictionary by seven Polish scholars (2 vols., Vilna 1856–61); Karlowicz and others (Warsaw 1900–); Kierst and Callier (English, Leipzig 1906); Linde (6 vols., Lemberg 1854–60). Standard grammars include those of Malecki (ib. 1863) and a 'Comparative Historical Grammar' by the same (ib. 1879); Krynski (Warsaw 1903); Malinowski (Posen 1870); Morfill (London 1884); Kalina (Lemberg 1883); Manassewitsch (Vienna 1892); Poplinski (1901); Smith (1864); Vymazal (in German, Brünn 1884).

POLISH LITERATURE. Comparatively nothing is known of the Polish language previous to the 15th century. No literary remains in Polish have come down to us previous to that time. For the 15th century itself we have only the 'Florian Psalter,' 'The Song of the Virgin Mary' (Bogorodzico), 'Queen Sofia's Bible,' 'Jadwiga's Prayer Book,' and some Polish sentences in court decrees and town documents. But we have for that period the first Polish grammar, by Jacob Parkosz (+1455), in which the first attempt was made to stabilize the language. Whatever literary activity existed in Poland previously and for some time afterward, found its expression through the Latin language. The oldest author, who wrote in the first half of the 12th century, was Martin Gallus, the chronicler. Cholewa (+ 1166) wrote the mythical history of Poland in the form of a dialogue; Kadlubek (12th and 13th centuries), Bogufal, Baszko, Polak, Janko of Czarnkow were historians before Jan Dlugosz (1415–1480), the most famous of all the Polish historians. From the 13th century on there were many scientists in Poland, such as the physicist Ciolek, the humanist Gregory of Sanska, the astrologer and medical writer Glogowczyk, and many others who wrote in Latin. There was also a considerable number of famous preachers, such as Laskarysa, Nicholas of Blon, Vincent Kol.

In the 16th century Polish literature develops by leaps and bounds and soon reaches the Golden Age. The religious and political questions of the day, arising from the conflict of Catholicism and Protestantism, brought into the field a very large number of writers, such as Wujka, Orzechowski, Modrzewski. One of the most famous orators was Peter Skarga (1536–1612), and among the historians of the time are Peter Bielski (1495–), his son Joachim Bielski (1540–), Stryjkowski (1547–), who wrote in Polish, and Matthew of Miechow (+ 1513), Kromer (1512–1589), Gwagnin (+1614), Bzowski (1567–1627), who wrote in Latin. Among the scientists the first place belongs to Nicholas Kopernik, who wrote in Latin. In the belles lettres we start at once with a poet of the first order, Nicholas Rej (1515–1577), whose 'Personal View on the Life of an Honorable Man' enjoyed great popularity. Górnicki (1527–1603) dealt with the political troubles of the time, wrote his 'The Courtier,' which was based on Castiglione's 'Il libro del cortegiano,' and translated Seneca. Kochanowski (1530–1584) wrote political satires and a large number of elegies and epigrams, which had a great influence, not only by his trenchant criticisms of conditions, but also by shaping the language into a perfect instrument of expression. Other poets were Klonowicz and Szymonowicz, who wrote both in Polish and Latin, the three Kochanowskis and Zimorowicz, who wrote in Polish, and Krzychi, Jan Dantyszek, Janicki, who wrote in Latin. The satire took a peculiar turn in the 16th century. In the village of Babin a landed proprietor and a judge formed a «Babin Republic,» in which prattlers were proclaimed as statesmen and other officers were lauded in proportion to the incumbent's incompetency. The Polish kings took interest in the humorous republic, and the Latin writings of the Babin republic exercised quite an influence on the politics and the literature of the time.

The second period, which lasted through the 17th and half of the 18th century, is one of decay, and is known as the «macaronic, panegyric, scholastic» period, when the language itself was degraded by «macaronism,» that is, a senseless surcharging with Latin terms, which was a reflex of the confusion of ideas prevailing in political life. This period abounds in private memoirs, where chronicled events mingle with quasi-philosophic reflections. One of the sanest among these men, who wrote in Polish, was Starowolski (1588–1656); others were Pasek, Jerlicz, Andrew Fredro. Among the Latin chroniclers must be mentioned Piasecki (1586–1649), Albrecht Radziwill (1580–1656), Zaluski (+1711). Mlodzianowski (1622–1686), a Jesuit priest, excelled in the elegance of diction in a time which was rather poor in orators. Among the poets we have Twardowski (+1660), the most prolific versifier of contemporary events in the 17th century, Opalinski (1609–1656), who wrote chiefly satires, Waclaw Potocki (1622–1695), chiefly known for his epic, 'The Chocim War,' in which the language reminds one of the purity of the previous period, Kochowski (1633–1699), the official chronicler of John III, who also left a large number of Polish and Latin verses, mainly of a religious nature, Jerome Morsztyn (+1655), who stood under French influence and preferred satire, Andrew Morsztyn (1620–1700), a cousin of the former, who still more followed the French models, and also translated Corneille's *Cid* and the works of Tasso, Stanislaw Morsztyn (1630–), who translated Seneca and Racine, Elizabeth Druzbacka (1687–1760), one of the first Polish authoresses. The most famous of the poets who wrote in Latin was Sarbiewski (1595–1640), and there was a whole host of Latin panegyrists, who hardly deserve mention. The drama barely made a beginning, but none was good enough to survive.

The third period was one of regeneration and lasted until the appearance of Mickiewicz in 1822. In politics, Karwicki, Leszczynski and Jablonowski advocated a much more sober attitude than had existed in the time of political anarchy, and their view had much to do with reshaping Polish literature. Konarski (1700–1773) did probably more than anyone else to bring reason back to literature, and much was done to improve and settle the literary norm. Among the grammarians must be mentioned Kopczynski (1735–1817) and Mrozinski (1784–1839), while Linde (1771–1847) produced his enormous Polish dictionary in six volumes, the forerunner of Grimm's German dictionary and still the object of admiration of philologists.

We get now for the first time historians, as against the chroniclers of the previous period. Lojko (1717–79) wrote three volumes of 'Polish and Lithuanian Institutions' and a large number of historical essays. Albertrandi (1731–1808), an Italian by birth, wrote much on Wladyslaw Jagiello, the Casimirs, and Polish history in general. Naruszewicz's (1733–96) 'History of the Polish People' was a model for many historical writers. Other historians were Waga (1739–1801), Bandtke (1768–1835), Golebiowski (1773–1849), and documents were collected and discussed by Kitowicz, Wybicki, Niemcewicz, Kozmian, Kilinski and others. Mention must also be made of the political writers of the Four Years' Diet, Kollatay (1750–1812), Staszyc (1755–1826). Nor was there any lack of orators, in whom Poland had before abounded. We have Soltyk, Count Casimir Sapieha, Count Adam Czartoryski, Matuszewicz and the preachers Lachowski and Woronicz. The arts flourished, and in 1816 Czerwinski was able to write ‘A History of Polish Civilization and Learning from the Tenth to the End of the Seventeenth Century.’ We have also the literary historians Chrominski (1759–1810), Ossolinski (1748–1826), Bentkowski (1781–1852), Count Osinski (1770–1842).

The first poet of this period is Trembecki (1725–1812), who stood under the influence of Voltaire, and was interested in poetry just for poetry's sake. Wegierski (1755–1787) imitated Boileau and other foreign authors in his love lyrics. Krasicki (1735–1801) wrote mostly in a satirical vein. He gained his first reputation by his ‘Fables,’ wrote a ‘Mouseid’ and similar poems, several prose tales, and translated Ossian, Lucian and Plutarch. Naruszewicz, who has already been mentioned as a historian, wrote fables, satires, idyls and odes, translated Tacitus and composed two tragedies, ‘Guido’ and ‘Tancred.’ Karpinski (1741–1825), a court poet, wrote pseudo-classic idyls and religious songs of a more substantial value. Kniaznin (1750–1807), too, wrote to please the courtiers, but his ‘Centennial Celebration of the Victory at Vienna’ has more real worth. He translated Lafontaine, Ossian, Anacreon, wrote idyls in the style of the German Gessner, and a number of historical dramas. A more sterling poet was Woronicz (1757–1829), whose larger works, ‘Asarmot,’ ‘Lech,’ ‘The Wislica Diet’ were never finished, and whose ‘Hymn to God’ is the only one that has escaped oblivion. Niemcewicz (1757–1841) wrote a large number of dramas, among which the comedy, ‘The Ambassador's Return,’ is probably the best. He lived a long time in America, where he had come to join Kosciuszko. After his return to Poland he wrote some historical poems and devoted himself to historical studies, ‘The Reign of Sigismund III,’ ‘Memoirs of Ancient Poland’ and others. He also wrote his own memoirs and a number of novels, among which ‘Jan of Teczyn’ is probably the best. With him begins the Polish novel. Other poets of this period are Kozmian, Godebski, Keklewski, Morawski. The number of dramatic writers during this time is very great. The mediocre attempts of Princess Radziwill (+1753) and Bogomolec (1720–90) were soon followed by the successful adaptations from Beaumarchais and Molière, by Zablocki (1750–1821), who satirized the negative sides of Polish society. Boguslawski (1760–1829) began his dramatic career by translating for the stage; then he became the founder and manager of the Warsaw Theatre, when he wrote his best original drama, ‘The Cracovians and the Mountaineers,’ in which he introduced folksongs. Other dramatists were Wezyk, Felinski, Dmuszewski, Prince Czartoryski.

The Romanticism of the West naturally affected Polish literature as well. As in Germany, so in Poland, collections of folksongs appeared in the beginning of the 19th century, such as by Zaleski, Wojcicki, Pauli and a little later, the monumental collection in dozens of volumes by Kolberg. With the growth of the new movement the pseudo-classicism which had prevailed heretofore came to an abrupt end. Brodzinski (1791–1835) stirred up a discussion in 1818 by his review of ‘Classicism,’ and himself set the example for a new movement by his heartfelt lyrics and still more with his lectures on esthetics, which he began in 1822. He is chiefly remembered for his idyl ‘Wieslaw,’ in which he introduced scenes from peasant life, and is considered as the forerunner of the great Mickiewicz. The romanticism brought to the front the writers of the Ukraine, the last stronghold of a romantic past, such as Malczeski (1792–1826), Goszczynski, Zaleski, Padura, Grabowski, Groza. Malczeski (1792–1826) wrote an epic, ‘Maria, a Ukrainian Story’; Goszczynski (1803–76) is best remembered by his poem, ‘Saint John's Feast,’ which deals with the life of the Tatra mountaineers, and a number of ballads; many of Zaleski's (1802–86) lyrical poems have been set to music. These poets were far surpassed by the Lithuanian Adam Mickiewicz (1798–1855).

Mickiewicz gained his first reputation by some romantic ballads, ‘The Switez Maid,’ ‘Lilies,’ and with his epic ‘Grazyna’ and ‘The Wake’ accentuated the quarrel between the classicists and romanticists. Probably the best of his ballads is ‘The Three Budryses,’ though ‘Mrs. Twardowska,’ ‘The Little Fish,’ and many others are of an equally high order. A nine months' stay at Odessa was productive of a series of love songs in the setting of the Tartar Crimea. In 1834 there appeared his famous epic ‘Pan Thaddeus,’ in which he treated the romantic episode of Lithuania's last raid to enforce a legal decision. The remaining days of his life were dimmed by a deep mysticism.

The period was particularly rich in poets. Count Krasinski's (1812–59) greatest work is his ‘Undivine Comedy,’ a highly imaginative poem; Slowacki (1809–1849) produced three dramas in verse, ‘Kordyan,’ ‘Mazeppa,’ ‘Balladyna,’ and a number of poetical stories; Garczynski (1806–1833) wrote fiery sonnets of war; of Pol's (1807–1872) many songs, probably his ‘Sing of Our Land,’ written at Mickiewicz's request, excels for simplicity of diction and warmth of feeling; among the other lyrics of the time must be mentioned Gaszynski, Morawski, Witwicki, Jaskowski, Wasilewski, Lenartowicz, Ujejski, Romanowski, Balza, Grudzynski. Not less numerous are the epic poets. Syrokomla (1823–62) treated sentimentally the history connected with his native home on the Niemen and also tried himself in the drama and translated the Latin poets of Poland into Polish. Zielinski (1809–81) wrote an epic, ‘The Kirghiz,’ based on his banishment to Siberia. Other poets of this class are Zmorski, Bielowski, Falenski, Odyniec, Chodzko, Kòrsak. Kaminski (1777–1855) was the first one to change the state into a national institution, and at the same time Alexander Fredro (1793–1876) and his son John Alexander Fredro (1829–) produced for it a large number of comedies. Other dramatists were Korzeniowski, Magnuszewski, Anczyc, Balucki, Asnyk and many more.

The novel first found its expression in Rzewuski's ‘The Memorable Deeds of Master Seweryn Soplica’ (1839), after which Chodzko (1795–1861) produced his ‘Lithuanian Pictures,’ while Skarbek (1792–1866), Wojcicki (1807–79) and a large number of others enriched Polish literature with their excellent stories, but the palm of productivity and manysidedness belongs to Kraszewski (1812–), who accomplished the phenomenal deed of writing not less than 700 volumes in every imaginable line of literary endeavor. Among the distinguished historical writers must be mentioned Lelewel, Morawski, Moraczewski, Siemienski, Schmitt, Szajnocha, Liske, Szujski, while the history of literature is represented by Bentkowski, Wiszniewski, Lukaszewicz, Nehring; the history of language by Malecki; bibliography by Estreicher. There is not a line of literary work which does not count some eminent authors.

The last quarter of the 19th and the beginning of the 20th century continue the activities so auspiciously begun a century earlier. Comte's positivism during this time finds its expression in Swietochowski's historical essays, while in the novel its representative is Eliza Orzeszko, who appears as the advocate of progress and science. Others belonging to this school are Zacharjasiewicz, who described the dark sides of bourgeois life; Jez, who gave sketches of the Yugo-Slavs; Balucki, who championed the lower middle class. The greatest poetess of this period is Konopnicka, but the period is particularly rich in poets,—Brzozowski, Jankowski, Urbanski, Gomulicki and others. Sienkiewicz, too, had begun his career as a positivist, but when this fell into disrepute he turned his attention to the past, producing the famous trilogy, ‘By Fire and Sword,’ ‘The Deluge,’ ‘Pan Wolodyjowski.’ Among his very many novels dealing with antiquity, probably none gained such wide recognition as his ‘Quo Vadis.’ Positivism finds its last adepts in Prus, some of whose novels have been widely translated.

With Wietkiewicz's study, ‘Our Art and Criticism,’ naturalism makes its entry into Polish literature, and to this school belong Dygasinski, Zapolska, Sever, Reymont, while Zeromski and Sieroszewski may be denominated as impressionists. Meanwhile Cracow develops a school of modernists, among whom excel Lieder, Komornicka, while Szczepanski gathered together all these forces in ‘Zycie,’ a periodical founded by him in 1897. The number of talents in this group is very large. In addition to the names just given may be mentioned Tetmajer, Rydel, Zulawski, Perzynski, Mirandolla, Lada and later Przybyszewski, Laskowski, Kondratowicz, Soltan. This modernism deteriorated into decadence, but amidst it blossomed the poets of might, Orkan, Danilowski, Micinski, who sing of loftier ideals. It is hard to foretell what the regeneration of Poland has in store for it in literature, but the extremely rich immediate past presages a brilliant future.

Bibliography.— For a historical study of the Polish language consult the publications of the Cracow Academy of Sciences, and the works of Kaluzniacki, Leciejewski, Nehring, etc., and for grammar the works of Brückner, Krynski, Malecki, Matusick, Ulaszyn; for the dialects, Karlowicz, Dembowski and Blat. The Polish-English and English-Polish dictionaries of Rykaczewski (London 1849), Chodzko (Berlin 1874), Kierst (Leipzig 1896), will be found useful, while for a Polish-Polish dictionary Karlowicz's ‘Slownik jezyka polskiego’ (still in process of publication) will far surpass the excellent older one by Linde (Lwow 1854–60). Polish literature may be studied, in Polish, in the works of Bentkowski, Breza, Chmielowski, Wasilewski, Wiszniewski, but especially in *Wiek XIX, sto lat mysli polskiej* (Warszawa 1906–). In German we have the works of Brandes, ‘Polen’ (also in English, London 1903), Brückner, Kurtzmann, Lipnicki, Nitschmann, Weckowski and in English, N. Forbes, ‘Polish Literature,’ a lecture (London and New York 1911). In English we have also the collections of E. C. M. Benecke, ‘More Tales by Polish Authors,’ (New York 1916); Sir John Bowring, ‘Specimens of the Polish Poets,’ (London 1827); P. Sobolewiki, ‘Poets and Poetry of Poland,’ (Chicago 1883).

Leo Wiener.

POLISH SUCCESSION WAR, a conflict arising in 1733 from the contest for the Polish throne, between Stanislas Leszczynski and Augustus III of Saxony. (See Poland). Stanislas Leszczynski was supported by France, while Russia and Austria embraced the cause of Augustus III. The war, however, speedily assumed the character of a struggle on the part of France to undermine the power of Austria. While Leszczynski was besieged in Dantzig by a Russian force and finally compelled to flee, France, in alliance with Spain and Sardinia, overran Lorraine, Milan, Sicily and Naples. There was little active fighting, however, and in 1735 preliminaries of peace were signed at Vienna, confirmed by a definitive treaty three years later. Augustus III was recognized as king of Poland; Stanislas Leszczynski received the honorary title of king, with the duchies of Lorraine and Bar, which, on his death, were to revert to France; the dispossessed Duke of Lorraine was to be compensated with the Duchy of Tuscany on the extinction of the house of Medici; and Naples and Sicily were bestowed by the emperor on the Spanish infante, Don Carlos, in exchange for Parma and Piacenza. The peace treaty was finally settled at Vienna in 1738. See also Poland and consult ‘Cambridge Modern History’ (Vol. VI, New York 1909).

POLISHING AND POLISHING MATERIALS. The name polishing is applied to the process by which the surface of a material is made to assume the most brilliant appearance of which it is capable. The degree of polish or brilliancy which a given surface can take on is in general proportionable to the hardness of the material. The article to be polished must first be made smooth. The softer bodies, such as wood, alabaster, ivory, are smoothed by means of glass-paper and pumice-stone; metals, with emery, pumice-stone, and polishing-stones; glass, with sand and emery; and precious stones with emery. In the case of wood the polishing is effected by rubbing with French polish. Polishing wheels are commonly used in the case of metals, being discs of wood covered with leather, and on which pulverized tripoli, chalk-rouge, tin-putty, etc., is sprinkled. Diamond powder, or the powder of other hard stones, is used to polish gems. See Emery; Pumice-stone.

POLISHING SLATE, a rock occurring mostly in beds of the Tertiary formation. Texture, earthy, soft, friable. It consists of the silicious shells or envelopes of various species of *Diatomaceæ*, the number contained in a cubic inch having been reckoned to be about 41,000,000,000.

POLISHING WHEELS. See Polishing.

POLITIANUS, pō-lĭsh-ĭ-ā'nŭs, **Angelus** (Latinized form of Angelo Poliziano), Italian scholar and poet: b. Montepulciano, Tuscany, 14 July 1454; d. Florence, 24 Sept. 1494. His name was taken from his native town, the family name having been Ambrogini. He was educated at Florence, where he acquired great proficiency in the classics and in Hebrew; and studied the philosophy of Plato under Marsilio Ficino, and the philosophy of Aristotle under Argyropulo. The first production which brought him into notice was a Latin poem on the tournament of Giulio de' Medici. He assumed the ecclesiastical habit, and acquired by his accomplishments the favor of Lorenzo de' Medici, who made him tutor to his children, and presented him with a canonry in the cathedral of Florence. In 1484 he visited Rome, and met with a flattering reception from Pope Innocent VIII. After his return to Florence he lectured with distinguished success on the Latin and Greek languages. Among the most famous of his writings are an account of the conspiracy of the Pazzi; a Latin translation of Herodian; a collection of Greek epigrams; the Latin poem 'Rusticus'; 'Paulpistemon'; and 'Sylvæ,' a collection of odes, epigrams and short Latin poems; beside some miscellaneous works in prose and verse, and a drama on the story of Orpheus, printed in 1475. This latter piece was set to music, of the science of which he was passionately fond, and is considered the earliest specimen of the opera, or Italian musical drama. As a Latin writer he may be reckoned one of the first who introduced that age of revived classical Latinity which forms so prominent a feature in modern literary history. He was an industrious and skilful collator of ancient manuscripts, and gave great assistance to the editors in the early period of typography. He also extended his researches to jurisprudence, and contributed greatly to the correction and illustration of the 'Pandects.' His Latin works, including 12 books of 'Letters,' were published in Paris, 1512. Consult Gresswell, 'Life of Politian' (1805); Serassi, 'Vita di Angelo Poliziano' (1808); Roscoe, 'Life of Lorenzo de' Medici' (10th ed. 1851); Symonds, 'The Renaissance in Italy' (1875–86), and 'Sketches and Studies in Italy' (1879).

POLITICAL CONTRIBUTIONS. See Corrupt Practices Acts.

POLITICAL CONVENTION. See Convention, Political.

POLITICAL ECONOMY. See Economics.

POLITICAL OFFENSES, those offenses considered injurious to the safety of the State, or such crimes as form a violation of the allegiance due by a citizen to the recognized supreme authority of his country. In the ancient times of the Roman republic offenses of this nature were comprehended under the name *perduellio*, and were considered equivalent to making war upon the State. In modern times the crimes considered political offenses have varied at different periods and in different states. In England the most serious political offenses are termed treason and those of a lighter nature, which do not aim at direct and open violence against the laws or the sovereign, but which excite a turbulent and discontented spirit which would likely produce violence, are termed sedition. (See Sedition). Political offenders of foreign countries are by English law not included in extradition treaties, and the secretary of state may order at any time a fugitive criminal accused or convicted of such crimes to be discharged from custody. In the United States also, and in most of the countries of Europe, the extradition treaties do not include the giving up of political offenders. After the United States entered the World War, the term 'political offenses' came to be applied to a considerable number of unpatriotic acts tending to belittle or hinder the national efforts put forth to win the war, and in a large number of convictions, especially long terms of imprisonment and heavy fines, were imposed by the United States courts.

POLITICAL PARTIES. See Convention, Political; Elections; Vote, Voters, Voting; Ballot; Primary, Direct; Primary, Presidental Preference; Caucus; Congress, and the parties by name.

POLITICAL PARTIES IN THE UNITED STATES. See United States, Political Parties in the.

POLITICAL PARTIES AND THE WORLD WAR. The fortunes of political parties depend to a large extent upon the popularity of the principles which they espouse, as indicated by their platforms and by the character of the men whom they nominate for office. The principles advocated by the political parties are determined in accordance with their respective points of view or reactions toward the leading questions or issues of a public character with which the country is confronted. Among such questions or issues, that of war is one of the most striking and important. This includes not only the question of entering the war but also that of the method of prosecuting it after it has been entered upon, and also the conditions of terminating it. Upon all three of these questions relating to war, political parties are likely to take different attitudes and to endeavor to attempt to carry out the policies which they respectively support through securing control of the government and the administration of affairs.

There are difficulties, however, in the assumption by political parties of different attitudes toward questions of war which do not arise to the same extent in connection with their division over questions of domestic policy. The principal issues upon which political parties have divided in the United States, during most of our history, have been those of a domestic or internal character. This has been due largely to our geographical isolation and lack of proximity to powerful or troublesome neighbors. There has, on the whole, been little attention paid to questions of our foreign relations and little popular understanding of such questions, and political parties have consequently, during most of our history, subordinated such questions in their platforms to those of domestic policy. Thus in time of war, partisan politics becomes comparatively quiescent because the issues upon which parties divide are usually domestic questions, while in war questions of foreign policy and international import become paramount, and these, being new and little understood by the mass of the voters, allow little opportunity for the appearance of decided party cleavage. A question of our foreign relations, however, which affects our vital interests so intimately as that of war cannot well be ignored by the political parties. Upon a question of foreign war, however, there is usually a much greater approach to popular unity and unanimity of public opinion than upon questions of domestic policy. Most persons subscribe to the view that party politics should stop at the water's edge and that, in case of war, it is the duty of every good citizen to support his country, whether right or wrong. It is true that, both in the War of 1812 and in the Mexican War, there was considerable dissatisfaction in certain sections of the country with the war policy of the government, but there was nevertheless less apparent difference of opinion over these wars than over equally important questions of domestic policy. It may also be noted that the opposition of the Federalist party to the War of 1812 contributed largely to the demise of that party.

Another difficulty in the way of injecting party politics into the question of the conduct of war is the necessity for a considerable degree of continuity of policy and stability of government if the war is to be brought to a successful conclusion. A government's foreign policy, in order to be permanent and constructive, should not be made the plaything of party politics, and this is especially true of war. The see-saw and ups-and-downs of party change which may be the evidences of the healthy fluctuations of public opinion in time of peace become dangerous in times of war if carried too far. For this reason, the party in power during the existence of a war, usually appeals for the support of the voters in order that a continuous policy and a united front may be presented to the enemy. The re-election of President Lincoln in 1864 was advocated on the ground that it was unwise "to swap horses while crossing a stream." Appeals were also made to the voters on this ground by leaders and supporters of the party in power in 1898 to elect a Congress composed of a majority of members of that party, although the Spanish-American War was then practically over. In England it is possible to postpone a general election by mutual consent during time of war, and thus avoid presenting to the voters the opportunity of swapping horses. Under the plan of astronomical government which we have in the United States, however, elections come regularly at stated intervals regardless of whether the country is at war or peace. For this reason, some sort of a party contest even during time of war is practically unavoidable. Moreover, on account of the organization of our national, state and local governments generally in accordance with the principle of separation of powers, as well as on account of the numerous elections and the large number of elective officers, it is necessary for political parties in the United States to maintain stronger and more permanent organizations than is required in other countries. Although a truce between the parties may be patched up at the outbreak of war, it is likely to be of short duration and to be broken as soon as party exigencies demand it at the approach of an important election. At such a time the opposition party cannot expect to maintain its organization intact unless it makes a contest to secure control of the offices wherever there is a fair chance of success. Under these circumstances, the necessity apparently rests upon the leaders of the opposition party to find issues and to carry the contest to the polls in spite of the existence of war and in spite of the fact that a considerable percentage of the rank and file of both parties is enrolled in the armies at the front and unable to participate in the election on account of practical difficulties.

The war has reacted somewhat differently upon political parties in European parliamentary governments than upon those in the United States. From one point of view the British cabinet is, in ordinary times, a party committee. It is a body of politicians selected from the leaders of the majority party, rather than a body of non-partisan technical experts; it is a parliamentary committee holding secret sessions and collectively responsible to the House of Commons. At the outbreak of the war it consisted of an unwieldy body of about 20 members. The war, however, has wrought fundamental changes in its character. At the very outset a party truce was agreed to, followed shortly afterward by the creation of a coalition cabinet of about the same number of members, containing practically all the prominent leaders of the two major parties, but with a nonpartisan technical expert, Lord Kitchener, in charge of the war office. The formation of the coalition cabinet sealed the party truce and indicated a significant departure, at least temporarily, from the ordinary plan of party control and responsibility. Certain other changes also followed in the train of the coalition cabinet. The cabinet ceased to be a mere parliamentary committee and less attention began to be paid to proceedings in Parliament, inasmuch as the latter ceased to affect or control the policies and personnel of the cabinet. The responsibility of the cabinet was rather to the electorate than to the House of Commons. That this responsibility had become individual rather than collective was indicated by the resignation in 1917 of the Secretary of State for India without affecting the tenure of office of the other members. Under these circumstances, the necessity for holding general elections ceased and acts were passed from time to time putting off the elections by prolonging the duration of the House of Commons.

The British coalition cabinet proved unsatisfactory, however, largely because of its unwieldy size, and smaller committees, selected partly from the cabinet and partly from outside were appointed to supervise particular phases of the administration. One of these committees was the war committee, which subsequently developed into the war cabinet of five members with Lloyd George at its head. The war cabinet, however, differed from the war committee in that the latter was a mere committee of, and subordinate to, the large cabinet, while the war cabinet was a small compact group of leaders of both parties which was superior to the ministry. For the most part, the members of the war cabinet were not burdened with the duties of administrative office, so that they could devote their whole attention to general matters connected with the war. The war cabinet was a manifest improvement over the cumbrous coalition cabinet, but even the war cabinet lacked the advantages which come from the concentrated power and responsibility of a single controlling head, such as we have in the United States.

We may now contrast the developments in the United States with those in Great Britain. In November 1917, Premier Lloyd George declared that he was almost the only minister in any land on either side who had been in office since the beginning of the war. Practically all the others had fallen by the wayside through one cause or another. This was not the case, however, in the United States. A few months after the re-election of President Wilson in 1916, many votes being undoubtedly cast for him on the ground that he had kept us out of war, he found himself unable longer to preserve peace and at the same time maintain the national honor and self-respect. The entrance of the United States into the war, however, produced no cabinet crisis as it had done in England. The same cabinet that had served in time of peace continued to serve without change after a state of war had been declared. A demand arose from certain leaders and organs of the opposition party that, following the example of England, a coalition cabinet should be formed, but the demand was unheeded. The opposition to the President's conduct of the war culminated in the attempt to secure the enactment of what was known as the Chamberlain war cabinet bill, providing for the appointment of a war cabinet "of three distinguished citizens of demonstrated executive ability," which should practically take the conduct of the war out of the hands of the President and usurp his constitutional functions as commander-in-chief of the military forces. This bill as proposed would probably have complicated the situation rather than simplified it, and was clearly unconstitutional, yet it was supported on the ground that such a war cabinet had been established in Great Britain with resulting increased efficiency in war administration, and we should consequently profit by her example. Such an argument, however, failed to take into account fundamental differences in the forms of the two governments. The Overman bill, which was finally enacted instead of the Chamberlain bill and gave the President power to co-ordinate and consolidate the scattered administrative agencies, was much more in harmony with the form and spirit of our institutions. The President neither could be, except by impeachment, nor ought to be supplanted in the conduct of the war. Stability of policy and administration in time of war is more important than that the personnel of the government should change quickly and readily in accordance with the changing currents of popular opinion and the ebb and flow of partisan politics. To secure such stability in Great Britain, a coalition cabinet was deemed necessary in order to avoid partisan criticism and struggle which might otherwise cause the downfall of the government through the loss of confidence in it by the House of Commons, to which it was responsible. No such coalition was necessary in the United States, however, since the cabinet officers are not responsible to Congress and are in no danger of an upset so long as they retain the confidence of the President, who is not only the head of the administration but also the leader of his party, and whose tenure of office is of course secure for the period of his term. The concentrated power and stability of tenure of the President makes for such efficiency in war administration as parliamentary governments are unable to attain except by abandoning the essential principle, that is, ministerial responsibility to Parliament, on which such governments are based. The argument that, because the establishment of the British war cabinet resulted in increased efficiency, such a plan would have the same result in the United States failed to take into account the fact that the establishment of the British war cabinet was a move in the direction of concentration of executive power, while such a cabinet, if introduced in the United States, would be a move in the direction of the diffusion of such power and responsibility.

Upon the entrance of the United States into the war, a party truce of a somewhat limited character was tacitly agreed to by the two major parties. In the nature of things, however, such a truce could be only temporary. As the summer of 1918 approached, President Wilson, in calling upon the members of Congress to attend to legislation rather than to go home to mend their political fences, made use of his well-known, laconic expression, "Politics is adjourned." Politics, however, was not adjourned *sine die,* but was liable to be reconvened in special session at the first opportunity. This opportunity came with the approach of the Congressional elections of the fall of 1918, which were the only elections of any importance held in the United States during its participation in the war. It is true that even in this election some traces of the party truce remained. In Minnesota the Democrats did not oppose the re-election of the loyal Republican candidate for United States senator. In New York City an agreement was reached between the leaders of the two major parties, in accordance with which each party endorsed the candidates of the other in three Congressional districts. These instances, however, were exceptional and were probably due in part to the belief that the election of the candidates whom it was proposed not to oppose was, in any event, a foregone conclusion. Party contests occurred generally in States and districts wherever there was a fair chance for the election of either candidate.

The Congressional campaign of 1918 attracted on the whole, as was natural, much less public attention than usual. Until a few days before election day, war news crowded political news out of the headlines of the newspapers. Underneath the surface, however, the political pot was simmering. The case of the Democrats, in the eyes of most of the Congressional leaders of that party, rested largely on the ground that, under their administration of affairs, the war was being conducted successfully. A huge army had been placed in France — an undertaking more gigantic than the country had ever before attempted, in comparison with which our efforts in the Spanish-American War were mere child's play — and yet there had been less mismanagement, inefficiency and graft than in former wars. President Wilson's claim for the support of his policies, however, rested on a loftier plane than mere military success or efficient management in the conduct of the war. In March, the President had issued an appeal to New Jersey Democrats in which he struck the keynote of service to humanity as the aim which the party should embrace. "The days of political and economic reconstruction which are ahead of us," declared the President, "no man can now definitely assess, but we know this, that every program must be shot through and through with utter disinterestedness; that no party must try to serve itself, but every party must try to serve humanity. . . . Every program must be tested by this question and this question only. Is it just, is it for the benefit of the average man, without influence or privilege, does it embody in real fact the highest conception of social justice and of right dealing, without respect of person or class or particular interest?" That the politicians of either party were likely to measure up to such a high standard was doubtful.

In the 14 conditions of peace which the President laid down in his January address and in other addresses he indicated his tenacious purpose of using force to the utmost, if necessary, in order to crush the German military autocracy, but at the same time showed his desire for a peace which would bring about reconciliation and brotherhood among the peoples, even including ultimately the German people if they threw off the yoke of their military masters. The President's holding out of the hope of peace to the German people on this condition was a powerful diplomatic weapon in his hands, as effective in its way as the military weapon of force, and he used it with marked success in the diplomatic notes which he dispatched in reply to the German government's appeal for an armistice. The President's belief, however, in the possibility of making a distinction between the autocratic German government and the German people was not shared by some of the more prominent leaders of the Republican party, and was also viewed with considerable scepticism by many persons who were not politicians. Former President Roosevelt went so far as to denounce President Wilson's 14 points as thoroughly mischievous and other Republican leaders emphatically disapproved of the President's policy in sending notes to the German government. The Republican leaders indicated their belief that the war was to be won, not through diplomatic appeals to the German people to overthrow their masters, but through the use solely of military force. This was natural, since any victory through diplomatic weapons would redound to the advantage of the administration, while a victory through military force would be more truly the work of the whole nation. They succeeded, however, in making many people believe that the President's policy meant a peace by negotiation and conciliation instead of a peace by dictation and force and that the Republicans were in advance of the Democrats in demanding the unconditional surrender of Germany.

President Wilson was handicapped, moreover, by the fact that there were many prominent members of his own party who were not wholly in sympathy with his policies, and, through the operation of the rule of seniority, some of these men had become chairmen of important Congressional committees. He felt, nevertheless, that the Republican leaders were even more out of sympathy with his policies than the large majority of Democrats and that, by their utterances, the former had already broken the party truce. Shortly before the Congressional elections, therefore, he issued a public appeal to the voters to return a Democratic majority to both the Senate and the House of Representatives in order to prevent "division of counsel and leadership" and to avoid the necessity which might otherwise arise of carrying on the government "amid contest and obstruction." The President's appeal was unusual, but was salutary as bringing about a public discussion of the political aspects of the war which had been partly lost sight of in the midst of important military developments. His main reason for issuing the appeal doubtless was that the possible control by opposite parties of the executive and legislative branches, respectively, would create an anomalous situation, — one liable to lead to difficulties if not deadlock in ordinary times and one especially to be avoided in a period of war and of reconstruction after the war when harmony between the executive and the legislative departments becomes even more important and desirable than usual. The election to the legislative body of a majority opposed to the executive would, in parliamentary governments, during ordinary times, lead to the resignation of the executive and to the establishment of an executive of opposite political complexion in harmony with the legislature. Such a mode of procedure on the part of the executive, however, is not feasible under the American system of government, for the resignation of the President would, of course, merely place the Vice-President in his office with no change of party control over the executive department. Under the circumstances, therefore, in case the opposition party gains control of Congress, that party may also attempt to control the President and harmonious relations between the two branches of government become more difficult to maintain. The President is practically reduced to the alternative of refusing to submit to the dictation of Congress, which may produce a deadlock, or of attempting by persuasion and by arousing public opinion through appeals to the country, to compel Congress to carry out his recommendations. The vital importance to the President, therefore, of having a Congress in harmony with administration policies was the principal justification for the President's unusual action. His appeal, however, was not sufficiently efficacious to save his party from defeat in the Congressional elections. The resulting likelihood that a conflict between the President and Congress would occur was foreshadowed by the passage by the Republican senatorial caucus, shortly after the election, of a resolution declaring that "Congress should assert and exercise its normal and constitutional functions, including legislation necessary for reconstruction."

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POLITICAL PARTY PLATFORMS. See Democratic Party; Republican Party, etc.

POLITICAL SCIENCE, the science which treats of the nature and organization of states with particular reference to their forms of government (q.v.). The late Sir John Seeley, one of the most profound students of political science, declared that «the state in the largest acceptation of the word, distinct from the family, though not unconnected with it, distinct also from the nation, though sometimes roughly coinciding with it, is the subject of political science; or, since the distinctive character of the state whereever it appears, is that it makes use of a contrivance called government, we may say that it deals with government as political economy deals with wealth, as biology deals with life, as algebra deals with numbers and as geometry deals with space and magnitude.» It is the province of political science to discover proper tests for the classification of governments as well as correct principles for the organization or administration of government. Whether political power shall be vested in the few or the many, what shall be the qualification of those who choose and those who hold government offices and mandates, whether a written constitution is preferable to an unwritten one, whether legislative, executive and judicial functions should be exercised by the same or different organs, whether the bicameral form of legislature has advantages over the single chambered body, the relation between government and liberty, the proper sphere of government activity, the conception and organization of sovereignty, the principles governing the organization and powers of the executive, the legislature and the judiciary are some of the problems of general political science. In its nature political science may be descriptive or historical. Descriptive political science deals with existing constitutions and treats of principles which are applied in practice. Historical political science treats of constitutions which have obtained in the past and of the growth and development of political ideas. Political science is sometimes said to differ from politics in that the latter has to do rather with the practical administration of government and from political philosophy in that the latter is concerned with a theoretical examination of the concepts which underlie political science. According to this distinction, political science has to do only with those political ideas which are scientific. It is closely allied to history and political economy. Its relation to history is ingeniously described by the eminent authority referred to above. He says that history is the *residuum* left when one group of facts after another has been taken possession of by some science. As this process of appropriation goes on, the *residuum* will eventually become the property of a single science — political science, a science which has for a long time been insensibly growing up by the side of history and in close connection with it. Political science draws many if not most of its materials from history, and the principles which underlie it are for the most part based on historical facts. Its relation to economics arises from the great part which economic influences play in determining the functions and scope of government. Thus the principles underlying the proper relation of government to industry as for example whether certain industries should be encouraged by bounties, subsidies or tariffs, are affected largely by economic considerations.

Formerly there was a disposition to deny that the study of the phenomena of the state could properly be described as a «science.» Political phenomena, it was said, are characterized by so much uncertainty and lack of order that it is impossible to apply to them scientific methods of investigation. This assumption, however, was based on a conception of science which was too narrow and strict. If we conceive the function of science to be the classification and study of facts through investigation and analysis and the deduction of conclusions therefrom, we are justified in holding that the phenomena of government constitute an appropriate subject of scientific investigation. It will be admitted, of course, that owing to the absence of fixed and immutable laws such as govern the relations of physical phenomena, the facts relating to political and social phenomena are less capable of evaluation and analysis than those with which the physicist and biologist are concerned; nevertheless it is impossible to say that they cannot be studied according to the rules of scientific investigation.

The recognized methods of political science may be classified as the experimental, the sociological, the comparative and the historical. To some extent states may also be studied biologically and psychologically and recently these latter methods have received much attention. The older and more generally accepted methods, however, are the comparative and historical methods. The comparative method was first employed by Aristotle and later by Montesquieu, de Tocqueville, Laboulaye, Mill and Bryce. This method aims through the comparison of existing polities to assemble a definite body of knowledge from which the ideal types of constitutions may be discovered. The historical method consists in the study of constitutions in their development and political working with a view to determining how far they have adapted themselves to existing needs and have fulfilled their original purposes. «It seeks,» says Sir Frederick Pollock, «an explanation of what institutions are and are tending to be, more in the knowledge of what they have been and how they came to be what they are than in the analysis of them as they stand.»

The experimental method in political science is obviously less satisfactory because the phenomena of government cannot be subjected to the process of artificial experimentation in the same way that physical phenomena may be analyzed and studied by the chemist, the physicist or the biologist. The latter may with the aid of applicances, heat, chemicals and the like isolate the phenomena which he desires to study, subject them to artificial processes and exclude the operation of disturbing influences. But the political scientist cannot do this. He cannot select a state, create artificial conditions for its study, employ mechanical apparatus and draw precise conclusions from the results. Nevertheless, the experimental method in politics is not entirely impossible. Indeed the whole political life of the state is in a sense a succession of experiments. Every new law, every new institution, every new administrative policy is experimental in the sense that it is regarded as tentative and provisional until experience has demonstrated its fitness to be retained permanently. In this way what Bacon called *experimenta fructifera* are constantly being made on every community, consciously or unconsciously.

Historically political science began with the ancient Greeks. Other primitive races lacked political consciousness. They had the consciousness of family and of class, but not of the state in the aggregate. By the common voice of posterity Aristotle (q.v.) is recognized as the founder of political science and his commentaries still occupy an important place in the literature of the subject. He it was who first gave to politics the character of an independent science. He mastered in the concrete a large number of constitutions, mostly Greek, and from the mass of facts thus gathered he laid down the body of general principles which constitute his system of politics. He was the first to classify governments as monarchies, aristocracies and democracies and although many of his other theories have long since been rejected this classification is still accepted as the most scientific and convenient. The corresponding perversions he designated as tyrannies, oligarchies and democracies. He laid down the important maxim that man is by nature a political animal and that, therefore, the state is necessary to a complete and all-sufficing life; he drew a distinction between ethics and politics; taught that the state was not an affair of mere convention but the result of growth and evolution; and discussed with scientific method the various types and forms of government, the theory of sovereignty, the institution of slavery and private property. Three elements, he said, were essential to every government. They were: a deliberative organization, a system of magistrates and a judicial organization. He asserted that the best constitution is one framed and administered for the common good, but that the best for one people was not necessarily good for all; that some are born to command and others to obey; he emphasized the principle of the responsibility of power and expressed the opinion that government by the middle classes was the most desirable. The chief merit of Aristotle's work was that he studied exhaustively the materials at hand and reduced to a clean-cut systematic form the general principles which he was able to gather from his studies. In other words he created a science of politics. Among his countrymen Plato (q.v.) was the only other scholar who contributed anything worth mentioning to political science and his treatment of politics was largely incidental to his ethical philosophy, it scarcely ever rising to the dignity of a science. In the 'Republic,' which was the greatest of his works, he formulated the conception of a state in which absolute justice prevails — an ideal commonwealth such as has never existed, in fact, nor probably ever will. Three classes, he affirmed, were necessary to every state. They were producers, warriors and magistrates, and every member must be assigned to the class for which he is best fitted. He did not recognize the right of private property, but insisted upon a uniform system of public education. In fact he believed that the only true way to the perfect state was through education. The function of the magistrates was to be limited — practically to the training of children, every detail of their early life being prescribed by the state. His idea of government was that of the aristocratic form; but he believed in an aristocracy of merit rather than of wealth. He proposed that philosphers should constitute the governing class, to exclude poetry from the state, to place women on an equality with man so far as political and military obligations were concerned. Some of his teachings, however, were not purly utopian; such for example as the opinion that the strength of the state was virtue and education, and that the guaranty of civil liberty could only be had in a well-balanced constitution. His classification of governments was the same as that of Aristotle except that he added two other types, namely, tyranny and oligarchy. In the 'Laws,' which is his last and most extensive treatise, he abandons somewhat his utopianism and seeks to present a practical code for the government of men. It proposed regulations for the minutest details of domestic life and recognized the institutions of marriage and private property, which had no place in his earlier treatises. It was he, as Sir Frederick Pollock shows, who first worked out the theory that government is a special art and can be exercised only by competent persons. His idea of government by philosophers, however, would now be ridiculed. Strictly speaking, he had no theory of the state, and his political ideas generally have had little permanent influence upon the history of politics. The same may be said of the post-Aristotelian Greek scholars, although it may be said that the Stoics contributed the idea of the law of nature and the idea of citizenship.

In the domain of political science the Romans were servile imitators of the Greeks and, therefore, contributed little of permanent influence. They were successful rulers and administrators, were skillful in the formation of rights and accomplished wonders in the domain of jurisprudence, but when Rome became a world state, carrying with it the destruction of all independent political life, there was no place for theretical politics. The Latin mind, in fact, was not given to speculation. Polybius and Cicero are almost the only names among the Roman theorizers, and their investigations were confined entirely to the Roman state. Polybius produced a remarkable treatise on the constitution of Rome which had an important influence upon later Roman politics. His discussion of the forms of government is also worthy of note. In Cicero's political writings, of which the 'Laws' and the 'Republic' were the most notable, we find developed the idea of a mixed government, containing royal, aristocratic and popular elements — a type which Cicero believed would prove to be most stable because of its triune basis. His classification of government was the same as that of Aristotle. Cicero's most important contribution to political science was the presentation of a clear and definite conception of natural law, which he defined as the supreme principle common to all nations.

During the Middle Ages few or no important contributions were made to political science. As James Bryce points out the Mediæval period was essentially unpolitical. The decisive spiritual force was religion. Political self-consciousness was lacking. One and only one great question dominated the political and intellectual life of the time and that was the long controversy between the temporal and spiritual powers. It involved the relation of Church and State and incidentally the nature of the civil power, the principle of the divine right of kings and the sovereignty of the people. A number of scholars, mostly theologians, arose to defend the claims of the Church to supremacy over the civil power. Of these, John of Salisbury and Saint Thomas Aquinas were probably the most notable. In the ‹Polycraticus› the former discusses monarchy as a form of government and justifies the crime of tyrannicide; in the ‹Summa Theologia,› one of the greatest treatises of the Middle Ages, the latter discusses various kinds of law, natural justice, the nature and forms of political authority and the functions of government. On the other hand, Dante, Occam, Marsiglio of Padua and other jurisconsults defended the claims of the civil power. To mention the most important of the numerous treatises that followed, Dante's ‹De Monarchia› discussed the monarchial form of government as the best of all forms and asserted that a universal monarchy on the old imperial lines was necessary for the highest development of mankind. A universal monarch, he said, having no rival to fear and no further ambition to satisfy, could have no motive for ruling unjustly. Occam's and Marsiglio's discussion of sovereignty and representations are of interest only to the student of political theory. Modern political science really begins with Machiavelli, an Italian who wrote during the latter part of the 15th century. He was devoted to the study of political science and like Aristotle regarded the state as the highest good. His chief works were the ‹Discourse on Livius› and the ‹Prince,› the latter a treatise which was designed to furnish advice to princes as to how they might best obtain their ends. The treatise is chiefly notable for its details of statecraft rather than for any theory of the state. It makes a complete separation of ethics and politics, in fact takes no account of morality. Into politics he introduces cruelty and bad faith, and teaches that a prince is justified in resorting to deceit, treachery, treason, cruelty and even murder in order to accomplish his ends. For this purpose such conduct seemed to him to be perfectly innocent and he recommended it without scruple. In the following century an important contribution to the literature of political science was Languet's ‹Vindiciæ contra Tyrannos,› the first treatise which defined the relationship existing between rulers and subjects as one of contract. This is not to be confused with the principle of contract as a theory of the origin of the state. The work was also notable for its strong plea for resistance to rulers who violate the contract existing between them and the people. A monumental contribution to political science was Jean Bodin's ‹De Republica,› published in 1577. It is a polemical treatise conceived on the plan of Aristotle's ‹Politics› and is notable for containing the first definite enunciation of the modern political doctrine concerning the nature and location of sovereignty. He shows that in every independent state there must be some authority, whether single or collective, whereby the laws are enacted. This authority is the sovereign and being the source of law must be supreme over the law. «He is sovereign,» said Bodin, «who sees no one greater than himself except God.» He defines sovereignty as a «power supreme over citizens and subjects, itself not bound by the laws,» and asserted that it was a unit and hence indivisible. This view of sovereignty was in the following century adopted by Hobbes and ultimately came to be the generally accepted view of the publicists. He is entitled, says Sir Frederick Pollock, to share with Hobbes the renown of having founded the modern theory of the state. In the 17th century the two most distinguished names in the annals of political science are those of Thomas Hobbes and John Locke, both Englishmen, one a defender of the absolutism of the Stuarts, the other a defender of the Revolution and a champion of the sovereignty of the people. Hobbes' most famous treatise was the ‹Leviathan or De Cive› and the two most important principles which he there lays down relate to sovereignty and the origin of society through contract. Like Bodin he taught that sovereignty was legally unlimited and subject to no higher powers. The sovereign, he said, was a public personage vested with absolute power, it might be arbitrary, it might be benevolent. No subject had a right to resist the sovereign, for that would be violation of his contract with all the other members of the state. His political science made no place for popular sovereignty, but it was Hobbes' doctrine of the state of nature and the contract theory of the origin of the state that made his work most famous. His view of a state of nature was that of a presocial condition in which men were in a state of perpetual war with one another, each appropriating what he could get and hold by physical force. To escape from this intolerable condition and provide for the security of all, each was induced to resign certain of his so-called rights over all things and surrender them to some common authority, thus forming a mutual covenant for the protection of other rights. Each entered into a contract with all by which he agreed to divest himself of the natural liberty of hindering his fellow-men in their efforts to obtain the same right. Hobbes' doctrine thus differed from that of the ‹Vindiciæ contra Tyrannos› of Languet in holding that the sovereign is no party to the contract but only an authority set up as a result of contract among the subjects of the state. He, therefore, surrenders nothing, but retains his natural rights as though he were in a state of nature. Nor can he be accused of breach of contract, because he has promised nothing. The idea of justice had no place in such a state nor had the conception of private property yet arisen. Locke wrote as a defender of the principles of the Revolution of 1688 and his ‹Essay on Civil Government› is one of the most notable treatises on political science published before the 19th century. Like Hobbes he accepts the contract theory of the origin of society as well as the idea of the state of nature. He differed from Hobbes, however, in his view of the state of nature, holding that it was not a state of license or anarchy or a condition of perpetual warfare, but merely a condition in which men have no common superior. Each individual is limited in his action by the law of reason or natural justice, while the institution of private property, the right to labor, and the right of liberty, occupied an important place in the presocial state as he understood it. Hobbes' doctrine of the renunciation of rights to an absolute ruler he also rejects. Locke's doctrine had more influence perhaps on American political philosophy than those of any other man.

Passing over minor writers of the period we are brought to Montesquieu, who about the middle of the 18th century made several monumental contributions to the literature of political science, the most notable being his 'Esprit de Lois,' published in 1748, a work which was the result of great study and research. It has been said that his two main ideas were: (1) the construction of a comparative theory of legislation and institutions adapted to the political needs of different forms of government; and (2) a comparative theory of politics and law based on wide observation of the actual systems of different lands and ages. He discussed intelligently the various forms of government, the corruption of democracies, the influence upon politics of the elements of air, sun, geography, climate, race, etc. Perhaps the best known and the most permanent in its effects of Montesquieu's political doctrines was his theory of the separation of powers and of checks and balances in government. The idea of the threefold character of governmental powers (legislative, executive and judicial) was as old as Aristotle, but it remained for Montesquieu to show that the exercise of each group of these functions by separate and distinct organs was an essential condition of liberty. If all these functions are exercised by one and the same organ, that is, if the same organ legislates, interprets and executes, its legal sanction is that of a tyrant. This principle was destined to have a large influence upon the political development of the United States and was in the course of time adopted by all the States and by the national government.

The last contribution of note in the field of political science in the 18th century was that of Jean Jacques Rousseau. This contribution consisted (1) of his theory of sovereignty and (2) of his theory of the social contract. As opposed to the doctrine of the jurisconsults who held that the will of the prince was law, Rousseau asserted the omnipotence of the people. In the 'Contrat Social,' his most notable work, the theory of the origin of the state as enunciated by Hobbes and Locke was elaborated. Like Locke, Rousseau maintained that presocial men were not in a state of perpetual warfare nor in a condition of unrestricted license. During the 19th century the names of De Tocqueville in France, Bluntschli in Germany, and Herbert Spencer in England, are perhaps the best known. De Tocqueville's 'Democracy in America' was a philosophical examination of political institutions in the United States based to some extent on personal observation. Herbert Spencer's 'Political Institutions,' his 'Principles of Sociology' and his 'Man vs. the State' are substantial contributions to the literature of political science. The individualistic conception of government activity which he sets forth is perhaps the most notable plea for the *laissez-faire* principles to be found anywhere. Bluntschli's 'Theory of the State' is a profound treatise on the nature and attributes of the state.

In the United States the contributions to political science have, for the most part, been of little consequence. The American mind is practical rather than speculative, and while the Americans have shown great skill *in* the preparation of constitutions and the formulation of rights, they have given little attention to the scientific discussion of the state. Most of the principles of our political science were inherited from England. The ideas of natural rights, popular sovereignty, representation, etc., were the familiar doctrine of the Puritan revolution, while the idea of the separation of powers came from Montesquieu. The first and one of the greatest American treatises on political science was the 'Federalist,' written by Hamilton, Madison and Jay in 1788 to secure the adoption of the Constitution. But being a lawyer's brief, it lacks the element of an unbiased philosophical discussion. Thomas Jefferson contributed various ideas of a speculative character, but they never took the form of a systematic treatise and scarcely rose to the dignity of a scientific examination of the subjects treated. John C. Calhoun's 'Disquisition on Government,' written in 1850, is an original and profound essay on the nature of government, and has scarcely been surpassed by any other American contribution in this respect. Two other works deserving of mention are Francis Lieber's 'Political Ethics' and Theodore Woolsey's 'Political Science.' Lieber's work was the first approach to a systematic treatise on political science ever published in America and has had great influence upon the political thought of the nation. His 'Civil Liberty and Self-Government' also occupies a distinct place in the literature of the subject. A more valuable treatise still is Woolsey's work first published in 1877 and is without doubt the most scholarly and systematic presentation of the principles of political science which has appeared from the pen of an American. The most recent contribution is Burgess' 'Political Science and Constitutional Law,' which discusses in a profound way the nature and origin of the state, the conception of sovereignty and the relation of government to liberty. Probably no contribution has had such influence in clarifying American conception on these phases of political science.

(See also articles STATE; SOVEREIGNTY; and the sections on *Government* of the various countries). In addition to the works cited consult Pollock, 'History of the Science of Politics'; Seeley, 'Introduction to Political Science'; Dunning, 'Political Theory of the Ancient or Mediæval World'; Willoughby, 'The Nature of the State'; also 'Political Theories of the Ancients'; Garner, 'Introduction to Political Science'; Leacock, 'Elements of Political Science,' and Gettell, 'Introduction to Political Science.'

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POLITICAL AND SOCIAL SCIENCE, American Academy of. See AMERICAN ACADEMY OF POLITICAL AND SOCIAL SCIENCE.

POLITICAL SOCIETY AND DEMOCRACY. See DEMOCRACY, HISTORY OF.

POLITICS. See ELECTION; POLITICAL SCIENCE.

POLIZIANO, pō-lēt-sē-ä'nō, **Angelo.** See POLITIANUS, ANGELUS.

POLK, pōk, **Frank Lyon**, American lawyer, grandson of Leonidas Polk, the Rebel bishop: b. New York, 13 Sept. 1871. In 1894 he was graduated at Yale University and three years later at the Columbia Law School. In 1897 he began his practice in New York City, was member of the civil service commission of New York in 1907–09, and in 1907 and 1910 was member of the New York board of education. On 24 Jan. 1914 Mayor Mitchel appointed him corporation counsel, in which office he remained until his appointment on 16 Sept. 1915 as counsellor for the Department of State at Washington. During Secretary Lansing's absence in Europe as delegate to the Peace Conference, Mr. Polk was acting Secretary of State.

POLK, James Knox, 11th President of the United States: b. Mecklenburg County, N. C., 2 Nov. 1795; d. Nashville, Tenn., 15 June 1849. He was of Scotch-Irish ancestry and was reared near the North Carolina frontier amid the hard, simple surroundings of plain farmers. He was graduated at the University of North Carolina in 1818 and settled in Tennessee, where he studied law under Felix Grundy, then one of the foremost public men of the West. He was admitted to the bar in 1820 and he began the practice of his profession at Columbia in middle Tennessee. Becoming a member of Congress in 1823, he at once took sides against Henry Clay and became a leader of great force. He remained in the House of Representatives 14 years, serving two terms as speaker at a time when the bitterness of the sections, as displayed in Congress, made the office one of the greatest difficulty. He was recognized as an able Jacksonian Democrat in 1840, when he was occasionally discussed as a probable candidate for the Vice-Presidency. But the evenly balanced state of politics in Tennessee and the importance of the State in national affairs caused him to become a candidate for the governorship of the State in 1839. He was elected and served two years, but was defeated in spite of all Jackson could do for him in 1841 and again in 1843. Under these rather adverse circumstances, his candidacy for the Vice-Presidency with Van Buren in 1844 was widely pressed. But the one issue which determined the nominations of that year was the proposed annexation of Texas. A group of ardent Southerners and Democrats, led by Robert J. Walker of Mississippi, was bent upon compelling Van Buren to agree to annex Texas in case he were elected. Van Buren had never been willing to make an explicit declaration of his views on the subject. He had been badly defeated for a second term in 1840, in a way which caused him and his friends to think he was entitled to a renomination in 1844. As the time for the assembling of the Democratic convention approached Senator Walker and other Southerners pressed for a declaration. Van Buren visited Jackson in April and on his return called upon Henry Clay at Lexington. On his return home late in April he gave out a public statement opposing the annexation of Texas. What made this announcement so extraordinary was the fact that on the same day Clay, then at Raleigh, N. C., made a similar public announcement. The excitement all over the South was intense. Walker and others secured the release of Southern delegates to the convention which was to meet in May from their instructions to vote for the nomination of Van Buren. In the Northwest a similar desertion of the New York leader took place. When the convention met there was great turmoil. Van Buren was, however, promptly defeated. After some manœuvring Polk was chosen as the party candidate. He was an ardent Texas man. Calhoun who was then, as always, a powerful leader in the South, supported Polk with enthusiasm and he was elected. It was one of the few cases in American history when the issue was perfectly clear and when the people understood what was to be done in the event of the success of Polk. The Democratic platform declared pointedly for the reannexation of Texas and the reoccupation of Oregon, a vast region then little known to the country but held jointly by the United States and England. Polk favored the seizure of all of Oregon, upon the giving of a year's notice of his intention to Great Britain, and it was his known opinion on this subject that secured him the hearty support of Northwestern leaders like Cass and Douglas. It was what has been called the bargain of the Baltimore convention, that is, that Southern men would support the demand for all Oregon to the southern boundary of Alaska on condition that Northwestern men would support the plan for the annexation of Texas. Polk was an avowed expansionist and he was elected upon the issue, Clay being defeated for the third and last time. George M. Dallas of Pennsylvania, a popular protectionist, was the candidate for the Vice-Presidency, notwithstanding the fact that Polk had always been known as an opponent of the principle as well as the practice of a protective tariff. In spite of the difference of opinion Polk and Dallas made an able and successful administration. James Buchanan was Secretary of State and Robert J. Walker Secretary of the Treasury. George Bancroft was also a member of this Cabinet. Clay opposed the administration most bitterly and both Webster and Calhoun, in spite of the recent friendliness of the latter, were leaders of the opposition in the Senate. Few Presidents have met with such powerful oppostion in Congress, and Van Buren, with his friends, held aloof, refusing their support at critical times. Yet Polk completed the annexation of Texas, solved the Oregon problem, but without securing all of the disputed territory, settled the long standing tariff dispute between the South and the North and established a new treasury system which continued till the outbreak of the Civil War. No other President with the exception of Wilson has placed upon the Federal statute books so many and such vital general laws. Nor was this all. Polk sought to procure by treaty certain lands claimed by Texas in the autumn of 1845 and he hoped to purchase New Mexico and California, where only a few thousand Spanish-Mexicans lived. John Slidell was sent to negotiate these delicate matters. He failed and at the same time irritated the already angry Mexicans. Meanwhile a small American army under the command of Gen. Zachary Taylor had already occupied part of the area claimed by both countries. The Mexicans attacked Taylor and war ensued. Upon the receipt of the news of victories in northern Mexico great excitement was aroused in the United States. Westerners and Southerners volunteered in great numbers. Polk pressed the war with vigor but he did not restrain army and navy men or the land hungry elements of the country from crying for the annexation of the whole of Mexico. At one time Polk himself, urged by two or three members of the Cabinet, contemplated the dismemberment of the unfortunate country. At the close of the war, not only the Texan claims but New Mexico, Arizona and California were demanded and received by the American commissioners. Polk and his group of followers were undoubtedly the most imperialistic of American leaders. The result of their policy was the annexation of about 1,000,000 square miles of fresh and valuable territory. But in the imperialistic campaign, supported by the West and the South, a part of Oregon was lost to the United States. That created ill feeling in the North toward Polk. About the same time that Polk agreed to yield to Great Britain the northern half of Oregon, he angered Northwesterners by vetoing a bill which proposed large appropriations for the improvement of harbors on the Great Lakes and for the dredging certain rivers in the same region. This was the beginning of the schism in the Democratic party for which the defeat of Van Buren in the Baltimore convention had prepared the way; Lewis Cass, a friend of Polk, could not hold his followers in line. The Wilmot proviso, a direct attack upon the President's annexationist program, was attached to important legislation and became the cause of a most bitter conflict among those who had elevated Polk to the Presidency. As the Mexican War drew to a close, Polk saw that a renomination was out of the question. He recommended the nomination of Cass by his party, but Van Buren and his friends united with the Liberty Party men and the malcontents of the Northwest to form a new party which took the name of Free Soilers. They polled votes enough to defeat Cass and the Democratic party and Polk retired chagrined if not directly defeated to his home in the spring of 1849. But his work remained. He died the following June at the capital of his State. (See MEXICO, AMERICAN DIPLOMATIC RELATIONS WITH). Consult Jenkins, J. S., 'Life of James K. Polk' (Auburn, N. Y., 1850); Tyler, L. G., 'The Times of the Tylers'; Smith, Justin H., 'The Annexation of Texas'; Reeves, Jesse S., 'The Diplomacy of Tyler and Polk'; Quaife, M. M., 'The Diary of James K. Polk' (4 vols., Chicago 1910).

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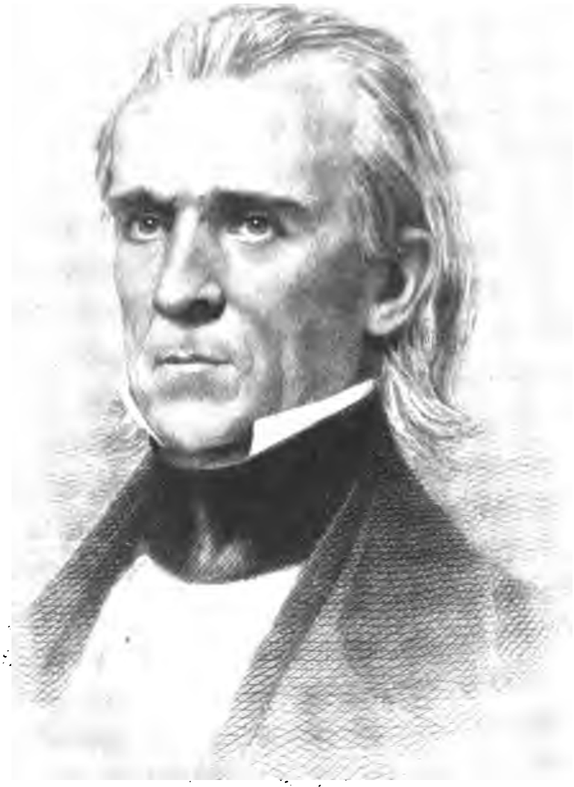
POLK, Leonidas, American general and Protestant Episcopal bishop: b. Raleigh, N. C., 10 April 1806; d. Pine Mountain, Ga., 14 June 1864. He was a cousin of President Polk (q.v.). Educated at the United States Military Academy, he subsequently studied for the ministry, and in 1831 took priest's orders in the Episcopal Church. In 1838 he was consecrated missionary bishop of the Southwest Indian Territory, Alabama, Mississippi and Louisiana. In 1841 he was appointed bishop of Louisiana, and his plan for a system of higher education in the South had its outcome in Sewanee University and the University of the South, established in 1858. He was an ardent lover of the South and soon after the outbreak of the Civil War was offered a major-generalship in the Confederate army and, accepting it, proceeded to fortify strongly strategic points on the Mississippi. At Shiloh and at Corinth he commanded the First corps; in October 1862 he was promoted to lieutenant-general, and in November conducted the retreat from Kentucky. In December 1863 he was promoted to the Department of Alabama, Mississippi and eastern Louisiana, and afterward joined Johnston in opposing Sherman's march to Atlanta. He was killed by a cannon ball while reconnoitring on Pine Mountain. Consult 'Life' by his son, W. M. Polk (1893).

POLK, William Mecklenburg, American physician, son of Leonidas Polk, the Rebel bishop: b. Ashwood, Maury County, Tenn., 15 Aug. 1844. He was graduated at the Virginia Military Institute in 1861; served in the Confederate Army under his father and rose to the rank of captain. In 1869 he was graduated at the College of Physicians and Surgeons of Columbia University, since when he has practised in New York. In 1876–79 he was professor of therapeutics at Bellevue Hospital Medical College; in 1879–98 professor of obstetrics and gynecology at New York University and since 1898 dean and professor of gynecology at Cornell University Medical College. Dr. Polk is consulting gynecologist to many hospitals in New York City.

POLKA, a dance of Bohemian or Polish origin, the name being derived from the Bohemian *pulka,* half, from the half-step that characterizes the dance, or from *Polka,* a Polish woman. Stainer and Barrett in their 'Dictionary of Music' credit the invention of the dance to Anna Slazak, a farm servant at Elbsteinitz, near Prague, about 1830. It was popularly introduced at Prague about 1835, and in 1839 was brought by a part of the musical band of the Prague sharpshooters, under the management of Pergler, to Vienna, where both the music and dance met with extraordinary acceptance. In 1840 it was received with the greatest applause at the Odéon Theatre in Paris, and was soon the favorite dance at all the public and private balls of that capital. It spread rapidly into every country of Europe, and is now common in every part of the civilized world. The music is written in two-four time, the first three quavers being generally strongly accentuated.

POLKO, pŏl'kō, Elise Vogel, German novelist: b. Leipzig, Germany, 31 Jan. 1822; d. Munich, 15 May 1899. She was a sister of Eduard Vogel, the African explorer, and attained considerable fame as a public singer, but retired from the stage after her marriage to Polko, a scientist, and thenceforth devoted herself to literature, in which field she won much notice. Her 'Musikalische Märchen' (1852) was translated into English, as were others of her books. She published 'Ein Frauenleben' (1854); 'Erinnerungen an Felix Mendelssohn Bartholdy' (1868); Aus dem Jahre 1870'; 'Conversations' (1872); 'Neues Märchenbuch' (1884), etc.

POLL-EVIL, a swelling followed by severe ulceration, on a horse's poll or nape of the neck, just between the ears toward the mane, which often results from a bruise, undue pressure of halter or similar injury to the flesh. As soon



JAMES K. POLK

Eleventh President of the United States

as it becomes evident that pus is forming warm poultices should be applied to hasten the process. When ripe the swelling should be lanced and kept open by a seton until thoroughly drained and clean and in condition to heal properly. Careful treatment is necessary to prevent serious injury to an animal so afflicted.

POLL-TAX. See CAPITATION; TAXATION.

POLLACK, or COALFISH, a dark green fish (*Pollachius virens*) of the cod family, a native of the Baltic, Northern and Mediterranean seas, and the name coalfish is derived from the dusky pigment which tinges the skin and which soils the fingers like moist coals. This species differs from the cod in seeking its food in shoals at the surface as well as near the bottom. In such surface excursions they pour out their spawn, which floats and quickly hatches. The flesh is highly esteemed on the British and Canadian coasts, but is not commonly known in the United States. Very similar fishes occur in the north Pacific, one of which is highly important to the Alaskan coast natives who call it beshow. All of these fishes yield a valuable liver-oil; and the eastern ones, at least, afford good sport with hook and line.

POLLAJUOLO, pŏl-lä-yoo-ō'lō, **Antonio,** Italian painter, sculptor and goldsmith: b. Florence, 1429; d. Rome, 1498. He was a pupil of Lorenzo Ghiberti and assisted him in the celebrated gates of the baptistery of San Giovanni. Chiefly known as a sculptor, his paintings, however, have a distinct place in the development of Italian art from their power in the expression of action, which quality is best exhibited in his ‹Hercules Strangling Antæus› in the Uffizi, and the ‹David› at Berlin. At Rome he made the monuments of Sixtus IV and of Innocent VIII. He was also a medalist and engraved several plates which are extremely scarce. His other occupations lend a certain character of hardness to his painting, which also exhibits his superior knowledge of anatomy, he being the first to study from dissection. His brother PIETRO,— b. Florence, 1443; d. there, 1496, was associated with him in all his works and did much independent painting. Pictures assigned to him are the ‹Annunciation› in Berlin and a fresco of Saint Christopher in the Metropolitan Museum, New York.

POLLAJUOLO, Simone del («IL CRONACA»), Italian architect: b. Florence, 1454; d. 1509. He studied the architectural remains of antiquity at Rome for a number of years before undertaking any original work; and his constant habit of describing them to his friends, after his return to Florence, won for him the title «Il Cronaca» («The Chronicler»). His masterpiece is the cornice added to the façade of the Palazzo Strozzi, of which he had been appointed architect. He built at Florence the Palazzo Guadagni and the church of San Salvador al Monte, also the sacristy of San Spirito, the court of the Palazzo Strozzi and the great hall of the Palazzo Vecchio. He must be looked upon as one of the leading architects of the original Renaissance style in Italy. Consult Geymüller-Stegmann, ‹Die Architektur der Renaissance in Toscana› (1885–96).

POLLAK, pŏl'ạk, **Gustav,** American editor: b. Vienna, 4 May 1849. After a course of study in the schools of his native city, he came to the United States in 1866, where he has devoted himself largely to editorial work. A contributor to *The Nation* from 1874, and to the New York *Evening Post* since 1881, he has written chiefly on foreign politics and literary subjects. In addition to copious work on leading encyclopedias, he has published ‹The Century Book for Mothers,› in which he was joint editor with Dr. L. M. Yale; ‹Franz Grillparzer and Austrian Drama›; ‹The Hygiene of the Soul›; ‹Michael Heilprin and His Sons›; ‹International Perspective in Criticism,› and ‹Fifty Years of American Idealism.›

POLLANARRUA, Ceylon, a ruined city and formerly capital of Ceylon, situated about 60 miles northeast of Kandy. There are numerous large stone figures of Buddha and remains of temples and other buildings. It flourished from the 8th to the beginning of the 13th century. It is now called Topare.

POLLARD, pŏl'ạrd, **Charles Louis,** American botanist and entomologist: b. New York, 29 March 1872. In 1893 he was graduated at Columbia University; was assistant curator of the division of botany of the United States Department of Agriculture in 1894–95, and of the United States National Museum from 1895 to 1903. From 1907 to 1913 he was curator of the Public Museum of the Staten Island Association of Arts and Sciences and from 1897 to 1913 was editor of *Plant World*. Pollard contributed many botanical terms to the Supplement to Webster's ‹International Dictionary› (1900) and the ‹Century Dictionary› (1903). He was the editor for botany and horticulture of Webster's ‹New International Dictionary› and has written many short articles. After 1917 Pollard was special field commissioner of the Boy Scouts of America.

POLLARD, Edward Albert, American journalist and author: b. Nelson County, Va., 27 Feb. 1828; d. Lynchburg, Va., 12 Dec. 1872. He was graduated from the University of Virginia in 1849, removed to California where he engaged in journalism, and was preparing for the Episcopal ministry at the outbreak of the Civil War, throughout which he was editor of the Richmond *Examiner*. An ardent supporter of the Confederacy, he was nevertheless a bitter and active opponent of Jefferson Davis. While endeavoring to run the blockade in 1865 on his way to England he was captured and imprisoned in Fort Monroe for eight months, when he was released by General Butler. He was an able writer, but bitterly opinionated and unfair where his prejudices were concerned. Among his numerous works are ‹Black Diamonds› (1859); ‹Southern History of the War› (1862); ‹The Lost Cause› (1866); ‹The Life of Jefferson Davis› (1869).

POLLARD, Josephine, American author: b. New York City, 1842; d. there, 15 Aug. 1892. She was an editorial writer on the *Sunday School Times* from the time of its establishment in 1876, and for 20 years was connected with the Methodist Book Concern. Her books are chiefly religious works and juvenile stories. Among them are ‹The Gypsy Books› (1873–74); ‹A Piece of Silver› (1876); ‹Decorative Sisters›

(1881); ‹Elfin Land› poems (1882); ‹Gellivor, a Christmas Legend› (1882); ‹The Boston Tea Party› (1882); ‹Vagrant Verses› (1887); ‹Favorite Birds and What Poets Sing of Them› (1888), and the hymn ‹Outside the Gate.›

POLLARD, Percival, American author: b. Pomerania, 1869; d. Baltimore, Md., 17 Dec. 1911. He came to the United States in 1885, engaged in journalism in 1891 and was afterward engaged in editorial and literary work in Chicago and New York. Among his published works are ‹The Cape of Storms› (1895); Posters in Miniature› (1896); ‹Dreams of To-day› (1897); ‹The Imitator› (1902); ‹Lingo Dan› (1903); and ‹Recollections of Oscar Wilde.› He also wrote the plays ‹Nocturne› and ‹The Ambitious Mrs. Alcott,› the latter produced at the Astor Theatre in 1908.

POLLARDING, the practice of cutting off the limbs of trees at a given height in order to make the stubs throw out numerous adventitious limbs. These latter, after being allowed to grow for three or four years, are cut for fuel and the process continued. In Holland and other parts of Europe where fuel is high-priced or scarce, the practice is very popular; but in the United States it has not come into vogue. It is also employed, like copses, for furnishing bark for tanning and withes for baskets, barrel hoops and wickerwork. Though the pollards, as they are called, are unsightly and are seemingly injured by the operation, they often become picturesque with age, and specimens still apparently thrifty are considered among the patriarchal trees of Europe. The species most used are willows, poplars, lindens, alders and certain elms and oaks.

POLLEN, John Hungerford, English clergyman and historian: b. London, 1858. He was educated at Münster, Germany, at the Oratory School, Birmingham, under Dr. (later Cardinal) Newman and at London University. In 1876 he entered the Society of Jesus and in 1891 was ordained to the priesthood. He has devoted his life principally to the study of the history of the Society of Jesus and of the lives of English, Irish and Scotch Catholics since the Reformation, and is vice-postulator for the beatification of the English martyrs. For purposes of research he has traveled in England, France and Italy. His published works are ‹Acts of the English Martyrs› (1891); ‹Life of Father John Morris› (1896); ‹The English Martyrs› (1908); ‹The Bedingfeld Papers› (1909). He edited ‹Papal Negotiations with Mary Queen of Scots› (1901); and ‹Queen Mary's Letter to Guise› (1904), both published by the Scottish History Society; ‹The Memoirs of Father Parsons› (1906–07); ‹Documents Relative to the English Martyrs› (1908), and contributions to ‹The Catholic Encyclopedia,› the *Dublin Review,* etc.

POLLICE VERSO, pŏl'lĭ-sē vėr'sō, the title of a famous picture by the French painter Gérôme. The words mean «with turned thumb,» and the artist represents the spectators in the gladiatorial games turning their thumbs down as the victorious swordsman sets his foot upon the body of his vanquished antagonist. When the thumb was turned up it meant that the vanquished swordsman was to be dispatched by the victor; it is not so plain that the downturned thumb meant mercy.

POLLINATION. The pollen grains of seed plants are really microspores in a more or less advanced stage of germination. They are developed within anthers and, at the time of shedding, form a powdery mass which usually has a distinctly yellowish color. The pollen is the male product of the plant. The transfer of the pollen to the female structures — to the ovule of Gymnosperms and to the stigma of the ovary in Angiosperms — is called Pollination (Fig. 1).

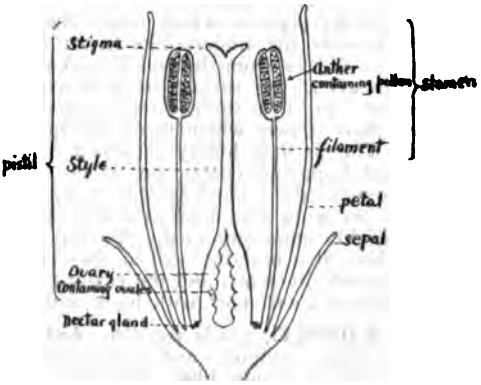


FIG. 1.— Diagrammatic section of a flower showing the various parts.

The terms pollination and fertilization are often confused, but they are very different processes; for pollination is merely the transfer of the pollen grains from the anther to the ovule or stigma, while fertilization is the union of the sperms and egg, or many would define the term more closely as union of the sperm and the egg nuclei. The confusion in the use of terms is particularly persistent because the earlier writers used both terms indiscriminately and because a widely read book by Darwin on ‹The Fertilization of Orchids by Insects› deals entirely with pollination, there being no reference whatever to the real process of fertilization.

The interval between pollination and fertilization varies in different species. In some cases it is only a few hours; in the majority of our familiar flowering plants the interval is probably less than a week; in some of the Gymnosperms it is several months, and in others, like the pine, it is a year; in the oaks, the interval is even longer.

Pollen is carried from the male to the female by the wind, by various animals, such as insects, snails and birds, or by water. The most primitive method is wind pollination; plants pollinated by wind are said to be *anemophilous.* Probably all Gymnosperms are pollinated by the wind, although claims have been made that in a few species the pollen is carried by insects. Many of the lower Angiosperms like the grasses, oaks, chestnut, beech and birch are wind pollinated; but the great majority of the group are pollinated by insects, and so are said to be *entomophilous.* In a few Angiosperms, growing in the water and with flowers resting on the surface of the water, the pollen floats on the water from the anther to the stigma. *Elodea,* a very common submerged water weed, is a familiar example.

The relative position of the pollen and the ovule or stigma to which it must be carried is various in different plants. In most of our familiar flowers, like the lily, the anthers with their pollen are in the same flower with the stigma. Such flowers are "bisporangiate" or "hermaphrodite." In many plants, as in corn, the male structures (the tassel with the anthers) and the female (the ear with the stigmas — called the "silk") are borne on different parts of the same plant but not in the same flower. Such plants are "monœcious." Many Gymnosperms bear male and female cones on the same tree and so belong in this category. In a smaller number of cases the male and female flowers are on different individuals, as in the willows. Such plants are "diœcious."

In case of wind pollination, the pollen is produced in immense quantities. In *Dioon,* a Gymnosperm in the cycad family, the male cone produces about 10,000,000,000 pollen grains. The female cone produces 200 to 300 ovules, each of which exudes at its tip a small sparkling mucilaginous droplet, which catches any pollen grains that chance to fall upon it. The combined surface of the 300 droplets would be less than an inch square, and yet, if a female cone is within 100 feet of a male cone, the ovules are likely to be thoroughly pollinated. As the droplet dries, the pollen grains are drawn down to the place where they begin to germinate and form pollen tubes. The pollen may be carried for miles, but at such distance very few ovules of an ovulate cone are likely to be pollinated. In pine forests, the pollen falls in such abundance that people call it "sulphur showers."

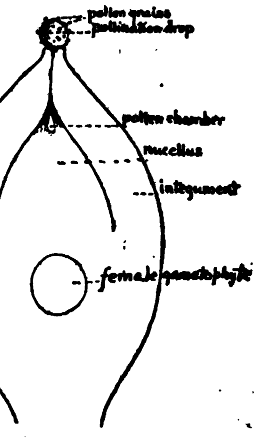


FIG. 2.—Longitudinal section of a Gymnosperm ovule showing the "pollination drop" with the very small pollen grains adhering to it. Below is the pollen chamber into which the grains will be drawn by the drying of the drop.

The comparatively few plants in which the pollen is carried by water are mostly diœcious. The pollen simply floats upon the surface of the water until it reaches the sticky, mucilaginous secretion of the stigma.

In case of wind pollination and water pollination the male and female flowers are usually upon different plants or, at least, upon different parts of the same plant. In these cases *cross-pollination* — the pollination of the stigma by pollen from another plant or from another flower on the same plant — results necessarily. Botanists agree that cross-pollination is the most efficient method and that *close pollination,* which results in close fertilization, is almost always bad for the species. However, there are some cases of efficient close pollination, chiefly in flowers which do not open, but always remain closed and, therefore, are called *cleistogamous* flowers. The common blue violet, in addition to its showy flowers, has small, nearly colorless flowers, looking like unpromising buds near the bases of the leaves. These flowers, entirely self-pollinated, produce good seed. But in most cases where the male and female structures, the anther and the pistil, are in the same flower, plants have worked out innumerable methods with innumerable variations in details to avoid close pollination. In nearly all of the cases, the pollen is carried from the anther to the stigma by insects. There are scores of books on insect pollination.

Most plants which are pollinated by insects have conspicuous flowers or a distinct odor or both. Some observers claim that the corolla does not attract insects, but none can deny the constant association of conspicuous flowers and insect pollination. All flowers pollinated by insects have nectar glands which secrete the nectar, which is the most usual cause of insect visits.

In many plants with stamens and pistils in the same flower, self-pollination is prevented by the maturing of the pollen and stigma at different times. The pollen matures and is shed before the stigma exudes the sticky substance which makes the pollen adhere to it and at the same time affords a nutritive medium in which the pollen tube begins to form; or the stigma matures and dries up before the pollen is ripe; consequently, the stigma could be pollinated only by pollen from another flower.

In many cases, however, the pollen and the stigma of a flower mature at the same time. In such flowers the devices to prevent self-pollination are innumerable. Practically all such flowers are pollinated by insects. Some of the devices afford a general protection against self-pollination, but others are so complicated and specialized that only certain insects with certain peculiarities in structure can reach the nectar, and so none but these favored guests are tempted to visit the flower.

A common contrivance for the prevention of self-pollination is seen in species in which some flowers have long anthers and short pistils, while others have short anthers of the same length as the pistil in the other flower and long pistils of the same length as the anthers of the short-styled flower. The Bluet (Houstonia) is a familiar example (Figs. 3 and 4). As the insect, usually a butterfly, thrusts its proboscis down the tube of a flower with short anthers (Fig. 3) to reach the nectar at the base of the ovary, the pollen adheres to the proboscis; then, as the butterfly visits a flower with a short style (Fig. 4) the pollen on the proboscis is at the right level to brush against the stigma and, at the same time, pollen from the long anthers adheres to the proboscis at the higher level, so that this pollen will be deposited on the stigma of any long-styled flower the butterfly may visit.

In the Snapdragon and similar flowers the two lips of the corolla are so tightly closed that small insects cannot get to the pollen or nectar, but the lips open when some heavy insect, like the bumble bee, alights upon the flower. Thus the pollen and nectar are not wasted upon visitors which would be of little or no use to the plant in effecting cross-pollination.

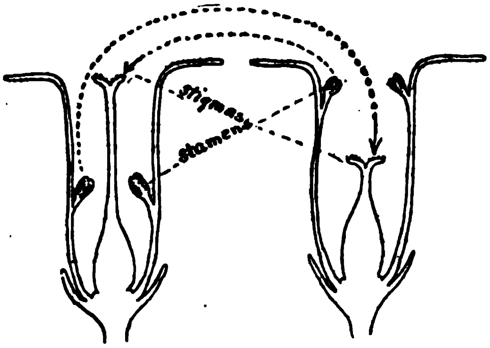


FIG. 3.—Long-styled flower with anthers near the middle of the corolla tube.
FIG. 4.—Short-styled flower with anthers near the top of the corolla tube.

The common milkweeds secrete a sticky, milky substance which hardens rapidly when exposed to air. The epidermis of those plants is very delicate in the region of the flower cluster, so that the sharp claws of ants or other creeping insects, which would be of no use to the plant in effecting cross-pollination, break through and the sticky substance holds them fast and prevents them from reaching the nectar or pollen. On the other hand, butterflies, which are very effective in accomplishing pollination in milkweeds, alight directly upon the flowers, securing the nectar and carrying the pollen to other flowers on the same plant or on different plants. In the milkweeds and in most of the orchids, the pollen grains stick together in large masses, called "pollinia" and, consequently, when pollination takes place at all it is very abundant.

The Catchfly (*Silene antirrhina*) as the flowers bloom exudes a sticky brownish substance which forms a girdle around the stem below the flowers, preventing any creeping insects from reaching the nectar or pollen. Consequently, pollination is effected only by flying insects. This hint from the Catchfly is used artificially on a large scale in the sticky girdles put around tree trunks to prevent the ascent of various pests.

Many plants, like the Evening Primrose, blossom only at night when there is not much danger from creeping insects, but when moths and other flying insects, particularly useful in effecting cross-pollination, are abroad in great numbers.

One of the Rosin-weeds, *Silphium perfoliatum,* has large sheathing leaves which form a cup around the stem. The water in the cup prevents insects from crawling up to the flowers. Only flying insects, which could carry the pollen to other plants, can reach the flowers. Many plants prevent self-pollination in this way.

In most of the cases mentioned, it is true the pollen of a flower is dusted upon its own stigma, but it is practically certain that when pollen from its own anthers and pollen from the anthers of another flower fall together upon the stigma, the foreign pollen is more likely to germinate.

A couple of instances of insect pollination, no more remarkable than scores of others, may be given as illustrations of the complicated relations between certain insects and certain plants. In the Fig, pollination is effected by small wasps. There are two kinds of urn-shaped inflorescences which we call figs, borne on different trees. One, which is called *Caprificus,* has male flowers near the neck of the urn and short-styled female flowers farther down; the other, called *Ficus,* has only female flowers with long styles. The wasp thrusts its ovipositor down through the short style of the female flower *Caprificus* and lays an egg in the ovary and a larva begins to develop, causing the flower to become distorted into a gall. As the wasps mature, the males escape first and fertilize the females which are still in the gall flowers. The males then leave the urn before the pollen is ripe, but the females stay awhile — just long enough for the pollen to ripen — and then escape, becoming dusted with pollen as they pass through the narrow opening at the top of the urn. Then they visit the younger urns, dusting the stigma with pollen and laying eggs. In case of the short-styled flowers of *Caprificus,* galls are produced; but the wasp's ovipositor is not long enough to reach the ovary of the long-styled flowers of *Ficus* and, consequently, pollen tubes develop normally, fertilization follows and normal seeds are matured.

Another remarkable instance of insect pollination is seen in the *Yucca,* an arborescent member of the lily family, with rigid, swordlike leaves, which has given it the name of "Spanish Bayonet" or "Spanish Dagger." Pollination is effected by the moth, *Pronuba yuccasella.* The female visits the flowers for the pollen, which she does not eat, but molds into a ball and carries to another flower. Here she bores through the wall of the ovary and deposits her eggs in the young ovules and then crowds the ball of pollen into the funnel-shaped top of the stigma, thus effecting abundant pollination, which causes the young ovules to grow rapidly. The developing larvæ eat many of the young ovules, but soon bore their way out and escape, while the ovules which are left develop into good seeds.

In the case of yucca and pronuba, the moth has been considerably modified so that it is adapted to rolling up the ball of pollen. Many flowers are adapted to pollination by certain insects and many insects are adapted to certain flowers, so that a scarcity of its particular flower means hardship or death to a certain species of insect; while a scarcity of some particular insect may mean the extinction of the particular flower which it pollinates. These mutual adaptations are very numerous among the orchids.

In all the foregoing instances, pollination results between flowers of the same species. When effective pollination occurs between plants of different varieties, species or genera, and fertilization follows, the resulting individual is called a *hybrid*. It often happens that hybrids are more vigorous than either of the parents and it is often possible to combine desirable characteristics of different species by artificial pollination. An anther is plucked out from a flower and its mature pollen is dusted upon the stigma of the other species. This method has been of immense value in improving various fruits and crops. It is well known that the male and female are equally potent in transmitting hereditary characters, but cross-pollination has shown that, in some cases at least, some particular characters are regularly determined by the pollen. In corn, if self-pollination be prevented and field corn, which has a starchy kernel, be pollinated with sweet corn, which has a sugary kernel, the field corn stalks will bear an ear with sugary kernels; and, similarly, starchy kernels can be grown upon sweet corn stalks. In corn, pollination by a red-eared parent will produce ears with red kernels or with kernels showing various mixtures of red and yellow. By pollinating different stigmas of an ear with different pollen, it is possible to produce on the same ear both red and yellow and also starchy and sugary grains.

There are scores of books on pollination and a vast number of articles in magazines. Dr. Knuth, in his exhaustive treatise, lists 3,748 titles, most of them dealing with pollination in connection with other features of the life history but many of them devoted entirely to this subject.

Bibliography.— Knuth, Dr. Paul, 'Handbook of Flower Pollination' (Oxford 1906). This work in three large volumes gives citations to practically all the literature up to 1906); Darwin, Charles, 'The Effects of Cross and Self-Fertilization of Plants' (London 1888), and 'The Various Contrivances by which Orchids are Fertilized by Insects' (New York 1892).

Charles J. Chamberlain,
Professor of Morphology and Cytology, the University of Chicago.

POLLIO, pŏl'ĭ-ō, **Caius Asinius**, Roman poet, historian and orator: b. 76 B.C.; d. 4 A.D. He is known from the part he took in the political events of his time, but still more by his writings and love of literature. In the Civil War, he (49 B.C.) adhered to Julius Cæsar, whom (after defeating Gaius Curius in Africa) he accompanied to Pharsalia and then to the African and Spanish wars. He was afterward appointed prætor and held the government of Further Spain, where he fought, without success, against Sextus Pompeius. When Lepidus and Antony were reconciled, in 43 B.C., he joined them with three legions and was made administrator of Transpadane Gaul. At this time he became the friend of Virgil, whose property he saved from confiscation. After obtaining the consulship he commanded in Illyria and Dalmatia and for his victories was honored with a triumph 39 B.C. He afterward devoted his time to literary pursuits. He wrote speeches, tragedies and a history of the civil wars, comprised in 17 books, which is quoted or referred to by several of the ancient writers. He was a great patron of literary men and introduced the custom (Recitatio) of reading aloud works, before publication, to a group of expert critics. Virgil addressed two Eclogues and Horace an ode, to him. His orations are frequently spoken of by Quintilian, but his style is condemned as deficient in clearness and ease. He founded the first public library at Rome. Three of his letters to Cicero are in the Ciceronian collection and there are some extant fragments of his history of the civil wars. Wolfflin has on very inadequate grounds attributed to him the history of Cæsar's African campaign ('Bellum Africanum'). He lived on intimate terms with Virgil and Horace, the latter of whom dedicated to him the first ode of his second book. Consult Aulard, 'De Asini Pollionis Vita et Scriptis' (1877).

PÖLLNITZ, pĕl'nĭts, **Karl Ludwig**, Baron, German author: b. Issomin, Prussia, 25 Feb. 1692; d. Berlin, 23 June 1775. He belonged to a noble family but became a soldier of fortune, serving at different times in the Austrian, Papal and Spanish armies. He later gained the favor of Frederick the Great, who appointed him his reader and master of ceremonies at his court, and he subsequently became director of the theatre at Berlin. During his career he twice professed the Calvinist faith from interested motives, but before his death returned to the Roman Catholic Church. His works are witty and amusing and include 'Etat abrégé de la Cour de Saxe' (1734); 'Lettres et Mémoires' (1738–40), etc.

POLLOCK, pŏl'ŏk, Sir **Charles Edward**, English judge and writer on law: b. 31 Oct. 1823; d. Putney, 21 Nov. 1897. He was a son of Sir Frederick Pollock, had no university training and read law with his father, becoming his private secretary during his service as Attorney-General. He was called to the bar in 1847, was elected bencher of the Inner Temple in 1866, acquired large practice, took silk (that is, became queen's counsel) in 1866 and was knighted in 1873. In the last-named year he was raised to the exchequer bench and through the judicature acts received in 1875 the status of justice of the High Court. For a number of years he reported special cases and wrote several works on County Court procedure, merchant shipping, the law of evidence and other subjects. As a jurist he exhibited a remarkable erudition, especially in curious and antiquated phases of the law, and as a referee he was criticized for a too common habit of compromise. Among his works were 'The Practice of the County Courts' (1851; subseq. eds., with supplements), and 'A Treatise on the Power of the Courts of Common Law to Compel the Production of Documents for Inspection' (1851).

POLLOCK, Sir **Frederick**, English jurist: b. London, 10 Dec. 1845. He was educated at Eton and Cambridge; in 1871 was called to the bar of Lincoln's Inn, and in 1882–83 was professor of jurisprudence in University College, London. Since 1883 he has occupied the chair of jurisprudence at Oxford and during 1884–90 was professor of common law in the Inns of Court. Since 1895 he has been editor of the Law Reports. In 1888 he succeeded his father in the baronetcy. He has several times visited the United States and in the winter of 1903–04 delivered a course of lectures at the Lowell Institute, Boston. Among his published works are ‹Principles of Contract› (1876; 6th ed., 1895); ‹Digest of the Law of Partnership› (1877; 7th ed., 1900; 10th ed., 1915); ‹Spinoza, his Life and Philosophy› (1880; 2d ed., 1899; reissue with addenda 1912); ‹The Law of Torts› (1883; 5th ed., 1897); ‹The Land Laws› (3d ed., 1895); ‹Introduction to the History of the Science of Politics› (1890; revised ed., 1911); ‹Oxford Lectures and other Discourses› (1890); ‹Leading Cases done into English and other Diversions,› a series of parodies of English poets as well as of typical cases at law (1892); ‹The Law of Fraud›; etc., in British India (1894); ‹A First Book of Jurisprudence› (1896; 3d ed., 1911); ‹The Etchingham Letters,› a novel in epistolary form (1899; with E. F. Maitland), etc. With F. W. Maitland he wrote a ‹History of English Law before Edward I› (1895; 2d ed., 1899). Other works include ‹The Expansion of the Common Law› (1904); ‹Introduction and Notes to Main's Ancient Law› (1906; 2d ed., 1908); ‹The Genius of the Common Law› (Columbia University lectures 1912).

POLLOCK, Sir George, English soldier: b. London, 4 June 1786; d. Walmer, 6 Oct. 1872. He was educated at Woolwich, entered the East Indian service as lieutenant of Bengal artillery, in 1835 became colonel commandant and until his death retained this post. He commanded the Bengal artillery in the Burmese War of 1824, in 1842 was made commander of the armies west of the Indus, 5 April forced the Kyber pass, 16 September entered Cabul. He was military member of the supreme council of India in 1844–45, a director of the East India Company in 1854–56 and held other offices. In 1859 he was made general, in 1870 field-marshal.

POLLOCK, Robert, Scottish poet: b. North Muirhouse, Renfrewshire, 1799; d. Southampton, England, 18 Sept. 1827. He was educated at Glasgow University, studied divinity and was licensed as a preacher by the Associate Presbytery of Edinburgh in the spring of 1827. He is the author of a series of ‹Tales of the Covenanters,› published anonymously when very young and a blank verse poem, ‹The Course of Time,› which in spite of many faults of execution enjoyed a wonderful popularity both in Great Britain and the United States. The former work, republished with his name in a single volume, contains three of his earliest productions in prose; originally issued anonymously, ‹Helen of the Glen,› ‹Ralph Semmell,› and ‹The Persecuted Family.›

POLLOCK, Walter Herries, English journalist and author: b. 21 Feb. 1850. He is a brother of Sir F. Pollock (q.v.) and was educated at Eton and Cambridge. He was called to the bar at the Inner Temple in 1874 and from 1884 to 1894 was editor of the *Saturday Review*. He has published ‹The Modern French Theatre› (1878); ‹Lectures on French Poets› (1879); ‹The Picture's Secret,› a novel (1883); ‹Verse of Two Tongues› (1884); ‹A Nine Men's Morrice› (1889); ‹Old and New,› verse (1890); ‹Jane Austen: Her Contemporaries and Herself› (1899), and ‹Lectures on French Poets›; ‹King Zub›; ‹The Paradox of Acting›; ‹The Ballad-Monger›; ‹Animals that Have Owned Us.›

POLLS. See Elections.

POLLUCITE, the chief mineral in which the rare element cæsium occurs as an essential constituent, another being castorite, and, therefore, its most important ore. It occurs in cubes, but usually in small crystalline, deeply etched masses, colorless, transparent and much resembling quartz. It is a silicate of cæsium, aluminum and sodium. It is found only in Maine and in the granite of the island of Elba.

POLLUX, pŏl'ŭks, **Julius,** real name Polydeucs, Greek sophist and grammarian: b. Naucratis, Egypt. He flourished about 180–192 A.D., was well educated by his father and afterward received instruction from Adrian the Sophist, later becoming a favorite in Rome of Marcus Aurelius and his son, Commodus, by the latter of whom he was appointed teacher of rhetoric at Athens. He wrote several works, all of which have perished except his ‹Onomasticon› or Greek vocabulary, dedicated to Commodus, whose preceptor he was. Each of its 10 books forms a separate treatise by itself and contains the most important words relating to certain subjects, with short explanations of their meaning. The words are not arranged alphabetically, but are given with little regard to rigorous system of any kind, according to the subjects treated of in each book. It has been found an aid of much value in the study of Greek art and literature. The first edition was published at Venice in 1502 and the best editions are those of Lederlin and Hemsterhuis (1706), Dindorf (1824) and Bekker (1846).

This scholar has been frequently confounded with another of the same name who lived in the 10th or 11th century of the Christian era and wrote a ‹Chronicle› or ‹Universal History› from the formation of the world to the time of Valeus. His work, which has come down to us, was edited by Biancoreé (Bonn 1779) and Hardt (Munich and Leipzig 1792).

POLLUX. See Castor and Pollux.

POLO, pō'lō, **Gaspar Gil** (sometimes written Gil Polo Gaspar), Spanish poet: b. Valencia, Spain, about 1530; d. Barcelona, Spain, 1591. Details concerning his life are few and contradictory. He studied law, and is doubtless identical with the Gaspar Gil Polo who was professor of Greek in the University of Valencia 1566–74. He occupied the office of town clerk at Valencia and in 1572 received an appointment under the government from Philip II, who apparently sent him to Barcelona in 1580. He wrote ‹Canto de Turia,› in which he sung the praises of his native city, but his fame rests upon the pastoral romance ‹Primera parte de Diana enamorada, cinco libros que prosiguen los siete de Jorge Montemayor› (1564), a continuation of Montemayor's ‹Diana.› Its originality is questioned among critics, but his work is clear in delineation of plot and possesses beauties of diction and rhythm far surpassing that of the first ‹Diana.› It is also noted for the number and variety of its episodes, raising its author far above the lyric level of his day. It ran through many editions in Spain, of which the best is Cerda's (1778) and has been translated into English, French and Latin. Cervantes excepts it from the list of books condemned to the flames, his somewhat puzzling statement that it should be guarded "as though Apollo had written it" being evidently a pun on the author's name.

POLO, Marco, Italian mediæval traveler: b. Venice, about 1250; d. there, 1324. His father, a man of noble rank, of Dalmatian origin, in 1271 took young Marco with him on a trading expedition to China and the East. The youth of 20 entered the service of the Great Khan, and traveled extensively through China and the neighboring regions. The travelers were finally desirous of return, and were allowed to accompany an embassy to Persia. Thence they made their way to Venice, which they reached in 1295. Later Marco commanded a fleet in a war with Genoa, in 1296 was taken prisoner, and did not secure his release until 1298. At this time he dictated to Rustigielo di Pisa the work of travel known as 'The Book of Marco Polo' published in French. Though his narrative made a great sensation, it was for many years regarded as a mass of fabrications and exaggerations. It had an undoubted effect, however, upon exploration; and later researches have confirmed the truth of many of the author's descriptions. It encouraged the Portuguese to find the way to Hindustan round the Cape of Good Hope, and it aroused the passion for discovery in the breast of Columbus, thus leading to the two greatest of modern geographical discoveries. It was long the sole authority possessed by Europe on the peoples of the Far East. The first Italian edition appeared in Venice in 1496, and has been often reprinted. There are now about 60 translations in various languages, including several English ones. The standard English edition is that of Yule (1875; revised 1904). An English version appeared in 1818.

POLO, an equestrian game, the object of the players being to strike the ball through the opponent's goal; all are mounted on ponies not exceeding 14½ hands and carry mallets about four feet long with which to strike the ball, made of light wood. The grounds are usually 900 feet long by 450 feet wide, level turf, at each end of which are located goal posts 24 feet apart. The proper number of players is four on a side, but a less number can play; combination and interference are important elements of success. But little is authentically known of the exact origin of the game, yet legends of the Orient give proof of its antiquity, and it is generally accepted that the game was played in Persia before the beginning of the Christian era, and had its origin in northern India. It is a matter of record that a game very similar to it was played by the Emperor Manuel Comnenus about the middle of the 12th century. Some authorities claim that the original home of the game was Tibet and that it reached India through Afghanistan. It was known and popular in most of the Himalayan countries. In 1870 polo was introduced in England by army officers who had been stationed there, and about 1885 it was introduced into the United States. The rules of the game in England and America differ materially, especially in the tendency of the English game to lessen the freedom of the player in order to increase safety; the game has always been popular with the British army officers, who have produced many of the leading experts. In America there exists a system of handicapping the players, thus giving the less experienced an equal chance. The demand for suitable ponies has developed the industry in the United States of breeding them through crossing the thoroughbred with the hardy Western ponies. In addition to horsemanship the game requires control of temper, quickness of observation, judgment, nerve and endurance; the United States army has done much to encourage the game at the various army posts, and introduced it at the West Point Military Academy. The central authority on the game in the United States is the Polo Association, composed of 34 clubs located throughout the country; it forms the rules, regulates the handicapping and arranges the tournaments, championships and other matches.

POLOCK, Moses, American publisher and bookseller: b. Philadelphia, 14 May 1817; d. there, 16 Aug. 1903. In his 14th year he began the book business, in which he continued until his death. He issued many books in fiction, the drama and general literature, and in addition dealt in old and rare books, becoming an authority in Americana. His shop for half a century was frequented by book lovers, and his collections of Washingtoniana and books printed by Benjamin Franklin were particularly notable. He had a profound knowledge of early Pennsylvanian history.

POLONAISE, pō'lō-nāz, a national dance of Poland, characterized by a slow movement in three-quarter time, and made up of a march or promenade; also the music for such a dance, in a peculiar rhythm used by many composers, but specially elaborated by Chopin in some of his finest works.

POLONIUM, an element discovered by Mme. Sklodowska Curie (1898), who, while examining some samples containing uranium obtained it from the complex mineral pitch-blende. Mme. Curie named it polonium in memory of her native land, Poland. Pitch-blende is a peculiar and very complex mineral found principally in Joachimsthal, Bohemia; Cornwall, England, and in some parts of this country, notably Colorado. It contains a large amount of the element uranium and is mined and worked over to obtain that element. It was from the refuse or waste left after the extraction of the uranium that Mme. Curie obtained polonium and afterward the far more important element radium. Polonium closely resembles bismuth in its chemical properties, and is found in company with that element when it is separated from the rest of the above refuse during the process of analysis. To separate the polonium from the bismuth is a matter of great difficulty and no sample of polonium has yet been obtained that is free or even approximately free from bismuth. The method usually used is that of fractional precipitation of the basic nitrates. A solution of the mixed nitrates of bismuth and polonium is made in concentrated nitric acid. Water is added until the liquid becomes cloudy. The white solid basic nitrates that separate at first contain a larger percentage of polonium than the original mixture dissolved in the acid. This process, repeated many times, gives a solid rich in polonium. The most important property of polonium is its radio-activity (see RADIUM). While radium gives off three kinds of rays or radiations called α, β and γ, polonium appears to give only one variety, the α rays. Polonium loses its radio-activity slowly, thereby differing from radium. It should be noted that some noted investigators in this field of radio-active substances deny the existence of polonium, claiming it to be merely a radio-active form of bismuth, its radio-activity having been induced by its association with radium in the pitch-blende.

POLTAVA, pŏl'tä-vä. See POLTOWA, RUSSIA.

POLYÆNUS, pŏl-ĭ-ē'nŭs, Greek writer: b. Macedonia, about 85; d. Rome, Italy, about 170. He wrote a historical collection of instances of military ruses employed by Greeks, Romans and barbarians. It was entitled 'Strategics,' or 'Stratagems,' and was inscribed to the emperors Marcus Antoninus and Lucius Verus. Two of its original eight books are lost, but the remainder contains much valuable information not found elsewhere. The first edition was published by Casaubon at Lyon in 1589; the best by Coreas at Paris in 1809; early English translation by Shepherd at London in 1793, and German by Seybold at Frankfort in 1793–94.

POLYANDRY (Gr. *polys*, many, *andres*, men, husbands), a marital relation subsisting between one woman and several men. Polyandry is found to exist in primitive and barbarous peoples in every age and everywhere. In antiquity we have the testimony of Herodotus for the prevalence of this custom among the Scythian peoples Agathyrsi and Massagetæ and the Nasamones, a people of northern Africa near the Greater Syrtis. A like report is made regarding the people of Libya by Aristotle, by Diodorus Siculus regarding the Troglodytæ and the Ichthyophagi on the coast of the Red Sea, by Cæsar regarding the inhabitants of Britain; Polybius finds unmistakable traces of the institution even among the Spartans. Till but a little while ago these reports of ancient authors were held to be abnormal and exceptional, for it was assumed that the primordial family had everywhere its origin in the marital relation of one man with one woman (monogamy) or of one man with several women (polygyny or polygamy). But the reports of modern travelers concerning the marriage customs of barbarous and uncultured peoples prove that among them polyandry is universal or at least usual; it is found in Malabar, the Marquesas, in New Zealand and throughout all the Pacific isles, in North and South America — in short, wherever mankind has not risen above a certain stage of social culture; nor is it confined to totally uncultivated peoples; to cite one example only, it is a legitimate custom among the Tibetans. Usually, but not always, in the Tibetan polyandric family the joint husbands of a woman are brothers, and the elder brother is credited with the paternity of the children, while the other brothers are uncles. It is the report of travelers that the female head of a polyandric family enjoys a measure of consideration and authority very unusual among barbarians; in some tribes it has grown into a real sovereignty. The universality of the custom is proof at least that over against the patriarchal family and descent through the male head of a monogamous family must be set the matriarchal family in which descent is traced to the mother; and that gynæocracy is of equal antiquity with patriarchy. Spencer, in his 'Sociology,' mentions several curious forms of the relation, each considered an advance on its predecessor, as (1) one wife has several unrelated husbands, and each of the husbands has other unrelated wives; (2) the unrelated husbands have but one wife; (3) the husbands are related; (4) the husbands are brothers.

POLYANTHUS, a name popularly applied to several unrelated plants, as a narcissus (*Narcissus tazetta*), and the tuberose (*Polianthes tuberosa*); but most commonly a certain primrose thought to be derived from *Primula elatior* as a principal parent; but perhaps a hybrid between *P. officinalis* and *P. vulgaris*, or a race developed from the last species. It is one of the most popular of its genus in American gardens. It is a hardy perennial herb with entire, simple leaves, leafless scapes terminated by an umbel of several to many early spring flowers mostly red, yellow or both these colors together. Some of the numerous varieties have two corollas one within the other and are called hose-in-hose or duplex. The plants may be grown from seeds, but individual varieties are usually propagated by division. They delight in cool, moist, shady places and rich, loamy soil.

POLYBASIC ACIDS, *in chemistry*, acids which possess more than one hydrogen atom capable of being replaced by a metal equivalent.

POLYBASITE, a black, metallic mineral, occurring in hexagonal, tabular crystals of orthorhombic symmetry. It is a sulph-antimonite of silver and copper, containing 75.6 per cent of silver, of which it is, therefore, an important ore. It occurs in many silver mines of Saxony, Mexico and the western United States.

POLYBIUS, pō-lĭb'ĭ-ŭs, Greek historian; son of Lycostas, a distinguished general and one of the heads of the Achæans: b. Megalopolis, Arcadia, about 205 B.C.; d. about 120 B.C. He was educated for arms and political life, and when about 169 B.C. the design of the Romans to make all the free states of Greece dependent became evident, Polybius took part in all the measures for the preservation of their independence. When, therefore, after the subjugation of Perseus (168), the Romans used less disguise, Polybius found himself among the 1,000 hostages whom the Achæans were obliged to deliver up to the Romans. His learning, virtues and talents soon gained him the favor of some of the most distinguished senators, especially Fabius and Scipio, the two sons of Paulus Æmilius. The hostages were not dismissed until 17 years had elapsed, when Polybius, who did not wish to see again his degraded country, remained in Rome, and entered into the service of Scipio Æmilianus. He accompanied him on his expedition to Africa, and was a witness of the destruction of Carthage in 146. He then went to Greece, where the Achæans had become involved in a war with the Romans. After the Achæan defeat he did much to obtain favorable terms of peace. His services were gratefully recognized by the erection of his statue in many towns. Polybius is the author of a historical work from the 140th Olympiad (220 B.C.) to the overthrow of Grecian independence (146 B.C.). It consisted of 38 books, besides two introductory books, containing a sketch of the Roman history from the taking of Rome by the Gauls. The first part of the work comprised a period of 53 years, from the beginning of the Second Punic War to the overthrow of the kingdom of Macedonia; the second part began with the war in Spain against the Celtiberians and Vaccæans, and ended with the destruction of Corinth. Although the affairs of Rome are the chief subject, contemporary occurrences in other countries are also related. We have of this great work only the first five books entire, and valuable fragments of the remaining books. Some of these fragments, as that containing an account of the Roman army, are of considerable length. In extent of political and military knowledge, Polybius is surpassed by no historian of antiquity. To him is also attributed the introduction of didactic politics into history — that is, of that manner of writing history which, by intermingling views of the causes, occasions and effects of events, is a useful introduction to politics. On the other hand, his style is destitute of beauty, and the narrative interrupted by lengthy digressions, which weaken the artistic effect. Livy was much indebted to Polybius after he came to the Second Punic War. Cicero mentions a particular work of his on the Numantian War. Casaubon, in 1609, published a complete edition of all that had till then been discovered of his works and made a new Latin translation of the whole. The most valuable editions of Polybius are those of Schweighauser (1789), Bekker (1844); L. Dindorf (1866–68) and Hultsch (1867–71). The history of Polybius has been well translated into English by Shuckburgh (1889).

POLYCARP, pŏl'ĭ-kärp, one of the apostolic Fathers of the Church, and styled by his disciple Irenæus a pupil of the apostle John: b. Smyrna, probably about 69 A.D.; d. there, 155. According to legend he was brought up by a noble Christian lady named Callisto, and was consecrated by Saint John as bishop of his native city. When the controversy about the time of Easter arose, he went to Rome to confer with Anacletus, who then occupied that see; and though he did not succeed in reconciling the differences between the Eastern and Western usages, the questions were discussed in the most friendly manner. During the persecution under Marcus Aurelius Antoninus he was brought before the Roman proconsul at Smyrna and urged to revile Christ, but he replied, "Eighty and six years have I served him, and he has done me naught but good, and how could I then revile my Lord and Saviour?" The people desired that he should be flung to the wild beasts, but he was sentenced to death by fire. The flames, however, according to the legend, played harmlessly around him like a swelling sail, emitting a sweet fragrance. When the judges ordered one of the executioners to run him through with a sword, the flames were extinguished by the blood that flowed from the wound. Polycarp is one of the saints in the calendar of the Church, and the 26th of January has been consecrated to his memory. He wrote several epistles, which were current in the early Church, but have all perished except one addressed to the Philippian Church, exhorting them to the practice of their Christian duties and the maintenance of the purity of the faith. There is another writing of that age of which he is the subject, a relation of the manner of his death, written by the Church at Smyrna, of which he was the bishop, addressed to the church of Philadelphia. Both of these epistles may be read in an English translation in a volume, published by Archbishop Ware, containing all the genuine remains of the Apostolic Fathers. Consult also Lightfoot, 'Apostolic Fathers' (1891).

POLYCHÆTA, pŏl-ĭ-kē'tạ, one of the two subclasses (the other being *Oligochæta*) of annelid worms composed of a large number of marine species, but only a few from fresh water, whose most striking characteristic is the presence of fleshy outgrowths (parapodia) on either side of each somite of the body, each strengthened by a number of bristles, the term, in Greek, meaning much hair. The group is separable into *Errantia* and *Sedentaria*. The *Errantia* are wandering forms which, while they burrow, can swim readily. They have a well-developed head provided with eyes, sensory tentacles and usually the mouth is armed with strong jaws. The parapodia are well developed and form the organs of swimming and usually serve also as gills. They are carnivorous, feeding upon other worms, etc. The *Sedentaria* live exclusively in burrows, and in some cases have the power to secrete tubes of horny matter, or even of lime, in which they dwell. Living in this way and not using the parapodia these structures have been reduced; while the head not infrequently bears gills and numerous long retractile tentacles which are used in obtaining food. These feed largely upon the microscopic life in the water and are without jaws. In the life-history of the Polychætes a larval form known as the trochophore is very common.

POLYCHROME BIBLE (Gr. *πολύχρωμος*, many-colored), an edition of the Old Testament scriptures printed in different colored type so as to show the various literary elements out of which, according to modern Orientalists, the several books were compiled. The editor is Prof. Paul Haupt of Johns Hopkins University, Baltimore, Md. The term is also applied to an American edition of the Bible, in which, in the New Testament, the words generally accepted as the utterances of Jesus Christ, and, in the Old Testament, the words quoted by him, or that have direct relation to incidents to which he referred, are printed in red.

POLYCHROMY, pŏl'ĭ-krō'mĭ, literally the use of many colors and generally used in the sense of decorative work by means of brilliant coloring or that which is brilliant in comparison with other work of the same class and character. Thus a fitting together of building-stones in patterns is polychromy, although the hues of the sandstone or limestone or marble are not positive nor strongly contrasted with one another. In French Romanesque architecture, as also in modern imitations of it, like Trinity Church, Boston, Mass., the sandstones are of two or three different shades of reddish brown, and an additional hue approaching buff; and yet this very moderate degree of contrast, when used deliberately in pattern, is called polychromy. On the other hand, polychromatic painting is always assumed to be in primary colors, or those which nearly approach them in brilliancy. Thus the painting of a Grecian Doric temple in the 5th century A.D. is known to have been in great measure carried out in the unmixed natural pigments as strong and pure as they could be procured; red and deep blue, with a free use of metallic gold in the form of gilt, bronze or the like, and the rather frequent introduction of such secondary colors as green and purple.

Color effects in architecture are as ancient as architecture itself. It never seems to have occurred to an Egyptian builder to leave his limestone walls unadorned with polychromatic effects, nor to the sculptor engaged in carving reliefs on those walls or statues to set up against them, that such human and animal forms could ever be left in the natural color of the stone. Sculpture was always completed by the paintbrush except in those cases where, chiefly for display or in the spirit of sacrifice, there was used a very costly and very hard material of some importance in its own surface and color. Thus an Egyptian statue of diorite or basalt, or a Roman statue of the imperial epoch wrought in black marble, or a portrait bust with the head and neck of white marble inserted into the draped shoulders and torso wrought in the most precious Oriental alabaster or beautiful veined marble from Greece or Numidia, would not be painted; and any polychromy that would be added by hand would be in the nature of gilding applied to the hair or the ornaments. So the bronze statue, highly esteemed for its material, which was always accepted as superior to marble or other natural stone, would receive eyes of hard natural stone or of glass, and perhaps gilding as mentioned above, but nothing more. On the other hand, some modern work in experimental polychromy has been carried further; thus the statues and busts of Charles Henri Cordier have been adorned with enamel applied freely to articles of costume, to the harp of an Egyptian harp-player, in addition to the approximation of the natural color of skin and of drapery. In the Paris Exposition of 1900 there were exquisite statuettes wrought in the precious materials, onyx, agate, alabaster and the like, with bronze of many colors or in other cases in carved and stained ivory. The most impressive piece of work of this kind was the statue by Ernest Barrias, ‹Nature Unveiling Herself,› a statue somewhat larger than life, of which the whole lower part, representing the body from the bust downward with a drapery, is wrought of a single block of marble of unusual beauty — a superb piece of red and purple veining — while the breast and shoulders, arms and head, are in white marble, the hair and eyes being stained and the veil is of a natural stone of a delicate buff or perhaps greenish yellow tinge.

Polychromy in painting has not been so commonly used in modern times. For some reason painting, when applied in merely flat and unchanging masses, is looked on with some contempt by modern decorators; and the artist who controls a more complete skill, whose painted work is characterised by all the art of gradation and harmony known to the modern world, abstains from doing such purely decorative work. It was not so in antiquity, for while no fragment remains to us of the highest development of chromatic effect in sculpture, on the other hand there were no texts more intelligible than those which set forth the practice of employing painters of name and fame to adorn with color the works of the sculptors. An early but most interesting example of what this work must have been is seen in the draped statue discovered on the Acropolis in 1883 and 1886. The color is disappearing rapidly; but when it was taken from the ground it was brilliant. The outer garment (himation or peplos) has in every case a rich border of two or three contrasting hues; the larger surfaces of the stuff are shown as covered with a pattern in spots or small foliated figures; and the under garment (chiton), where visible, is often painted in a strong, deep green, which was probably in the first place more nearly blue. Hair, eyes, lips and all the jewelry shown, such as earrings, are treated separately and with what seems to have been a free use of gilding.

The great masters of polychromy are, however, the Persians and the civilized races of Asia generally. Beauty of pattern is especially the Persian gift; but this merit is shared by the people of the Indian Peninsula and by the Chinese and the Japanese, and in a lesser degree by the Malays and the inhabitants of farther India. Even the peoples of very low civilization in the north, the original inhabitants of Siberia, showed a marked gift in the arranging of decorative patterns. Both the Japanese and Chinese use polychromy in their larger works, temples and the like, with great freedom and with perfect success; the Japenese limiting brilliant effects rather to the interior and to special details of the exterior, while the Chinese had at one time the great art of polychromatic building, using their enameled potteries with perfect freedom.

Russell Sturgis.

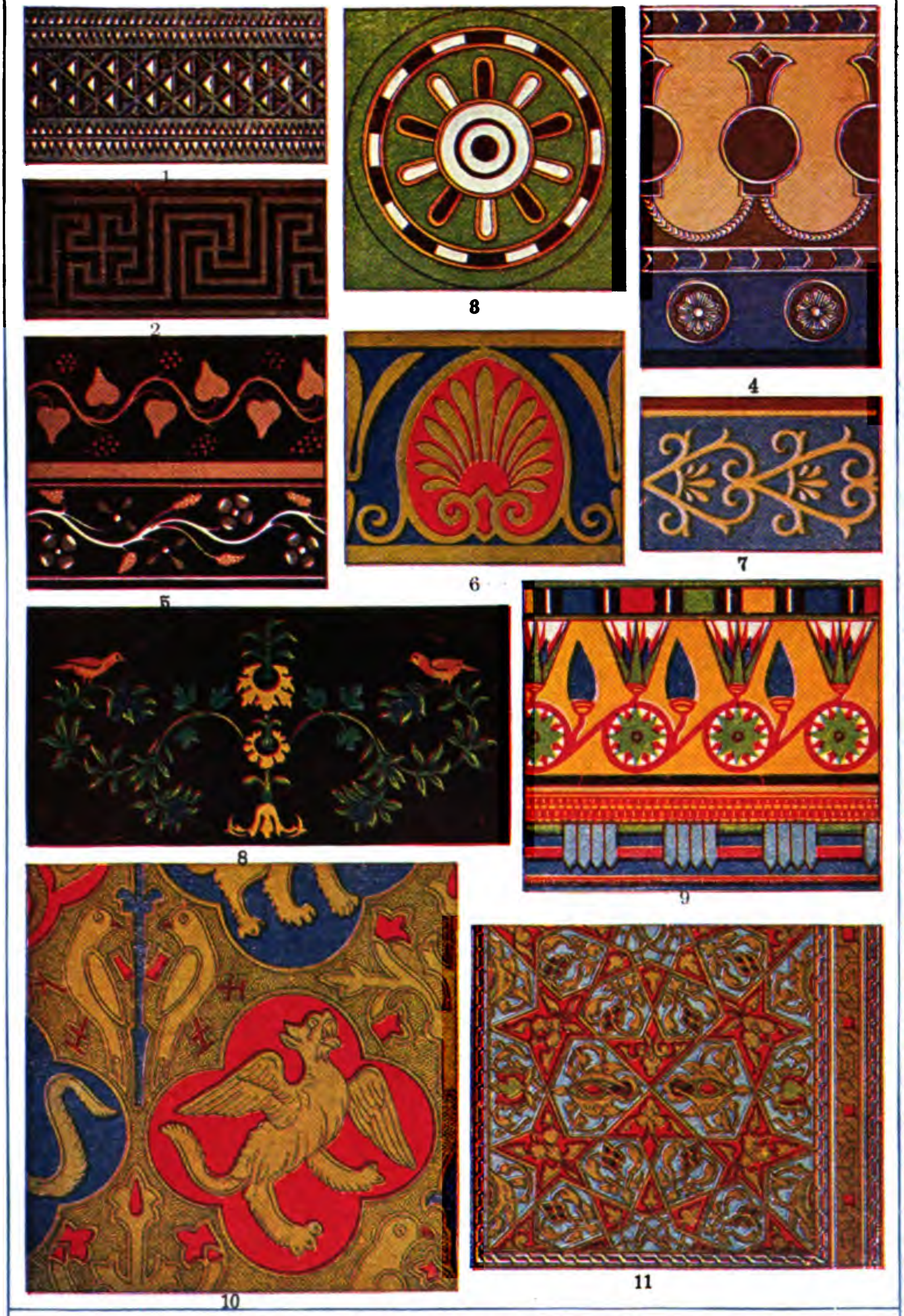
POLYCHRONICON, the name of a work of Ramolf Higden, a Benedictine (d. 1363). It is a history of the world according to Biblical chronology down to the year 1342.

POLYCLITUS (pŏl-ĭ-klī'tŭs) **OF SICYON,** Greek sculptor and architect. He was a pupil of the sculptor Ageladas, of Argos, in whose studio he became fellow-student of Phidias. He flourished 452–412 B.C. He stood at the head of the schools of Argos and Sicyon, and is held to rival Phidias, the head of the Athenian school. The latter was considered pre-eminent for his statues of the gods, and Polyclitus in those of men. He excelled particularly in representing the graceful attitudes of youthful athletes. One of his most celebrated statues was the Doryphorus (Spear-bearer), a figure to which the name of canon, or standard of beauty, was given, as in it the artist had produced a perfect ideal of the human form. Another statue of a young man, called ‹Diadumenos,› represented the subject fastening a band around his head. A group of two naked boys called ‹Astragalizontes,› playing with bones the game of tali, is also celebrated, as are some statues of Canephoræ, female figures carrying baskets on their heads. His

POLYCHROME [illegible]

1 Scallop Ornament from New Zealand.
ment from Saracen. 5 Grecian Plant [illegible]
Ornament. 9 Egyptian F[illegible]
11 [illegible]

POLYCHROME ORNAMENT



1. Scallop Ornament from New Zealand. **2.** Greek Meander. **3.** Assyrian Ornament. **4.** Scalloped Ornament from Nineveh. **5.** Grecian Plant Ornament. **6.** Palmetto, conventionalized. **7 and 8.** Pompeiian Ornament. **9.** Egyptian Flower Ornament. **10.** Animal Forms, 13th Century. **11.** Geometrical Arabian Forms.

statue of Hera, in the temple between Argos and Mycenæ, was thought by Strabo to be equal to Phidias' chryselephantine statues of Zeus and of Athena. The goddess was represented enthroned, wearing a garland on which were wrought the Graces and Hours; in one hand she held a pomegranate, and in the other a sceptre surmounted by a cuckoo. The head, breast, arms and feet were of ivory, and the robe of gold. As an architect Polyclitus won special fame from the theatre and rotunda, which he designed for Epidarus, which Pausanias pronounced to be the finest buildings of their kind ever erected. Polyclitus also wrote a treatise on the proportions of the human form. In addition to his fame as a statuary he has that of an able architect. One of his works, the theatre within the precincts of the temple of Æsculapius, at Epidaurus, was considered by Pausanias superior for its symmetry and beauty to any similar edifice extant.

POLYCRASE, a black, resinous mineral, occurring in prismatic crystals, chiefly in the granite of the island of Hitterœ, Norway, and in the Carolinas. It is of value for the rare earths which it contains, its composition being a mobate and titanate of yttrium, erbium, cerium and uranium.

POLYCRATES, pŏ-lĭk'rą-tēz, Greek tyrant of Samos; d. 522 B.C. He was one of the most daring, successful and treacherous of the Greek tyrants. Toward the end of the reign of Cyrus, about 535 B.C., with the aid of his brothers, Pantagnotus and Syloson, he conquered the island of Samos which had until then been free, and by banishing one brother and executing the other firmly established his power as sole ruler of the island. He raised a fleet of 100 vessels manned by 1,000 archers, seized several of the surrounding islands, conquered Miletus and defeated the Lesbians who came to assist the inhabitants of the latter city. Fired with the purpose of conquering the Ionian cities and the islands of the Ægean he formed an alliance with Amasis of Egypt. Herodotus informs us that Amasis, fearing the anger of the gods at the extraordinary good fortune of Polycrates in his many expeditions, persuaded him to make a sacrifice to the gods to avert misfortune. Polycrates thereupon threw into the sea a signet-ring of great value, which was found a few days later in the maw of a fish presented to him. Amasis considering his ally's doom certain, withdrew from the alliance. Grote, however, considers this story a fiction, and holds that it was Polycrates who broke off the alliance, perceiving it to be more to his interest to cultivate the friendship of Cambyses, who in 525 B.C. invaded Egypt. Polycrates sent to Cambyses 40 ships manned by the malcontents of his kingdom with the understanding that they were never to return. They escaped, however, returned to Samos and made war upon Polycrates, but were defeated, whereupon they gained the assistance of the Spartans and Corinthians and laid siege to Samos for 40 days, then abandoning the war. Polycrates continued prosperous, becoming more and more powerful until Orœtes, satrap of Sardis, nourishing a deadly hatred against him, treacherously contrived to lure him to his palace where he had him crucified. Herodotus says of Polycrates (iii, 125) that he perished in a manner unworthy of himself and of his high designs, and that none of the Greek tyrants, with the exception of those of Syracuse, were to be compared with him in greatness of character.

POLYDIPSIA, excessive thirst, such as usually accompanies diseases in which high temperatures occur. In diabetes especially it is a characteristic symptom, and the name polydipsia was formerly often given to this disorder. See DIABETES INSIPIDUS; DIABETES MELLITUS.

POLYEUCTE, pō'lē-ėkt'. Polyeucte was an Armenian Christian who suffered for his faith under the persecutions of the Emperor Decius and was afterward canonized, his day being the 9th of January. His name would no doubt to-day be no more widely known than that of the obscurest of the noble army of martyrs had not Pierre Corneille chanced to see in the story of his conversion and martyrdom the material for a tragedy and created from it a masterpiece, with the result that, as he said, "many have learned the name of Polyeucte rather in the theatre than at church." It was a bold venture to use the language and sentiments of Christian faith on the stage, where the prestige of classical models had established the mythology of antiquity. They were held to be too sacred for such profane use. Corneille's friends of the inner circle of taste of the Hôtel de Rambouillet remonstrated with him and predicted the failure of his play. But they were wrong. His picture of the triumph of faith in the heart of the new convert and of the serene and joyful courage with which it is confessed, more still perhaps the appealing figure of Pauline, one of the noblest of Corneille's women, so steadfast in her wifely duty in the shock of the unexpected return of the lover mourned for dead, so surely after the manner of the Cornelian hero, the "captain of her soul" won the applause of the public. It proved to be one of the most successful of his plays, as it is one of the best. It is the one that is perhaps the most wholly his own creation, the most happily constructed dramatically, the most noble and at the same time most simple in thought and language. The critics continued to disapprove its use of religion, and the 18th century quite discredited it as offensive both to its taste and to its opinions. But the 19th century restored it to the rightful place of honor, which it continues to hold.

ARTHUR G. CANFIELD.

POLYGALA, a genus of annual and perennial herbs and shrubs of the family *Polygalaceæ*. The species, of which about 200 have been described, are widely distributed in temperate and tropical climates; about 100 are North American. Some of the exotic species are cultivated in gardens and greenhouses; for example, *P. paucifolia*, common from Nova Scotia to Manitoba and south to Georgia; and *P. chamæbuxus*, a European species. The former is popularly known as gaywings, fringed milkwort, flowering wintergreen, and fringed polygala; the latter as box-leaved milkwort. *P. lutea* is one of the handsomest American species. The roots of *P. senega* and of *P. crotalarioides* have been reputed remedies for snake bites, the former in America, the latter in the Himalayas. The American species is known as snake-root, seneca-root, senega-root and mountain flax. *P. polygama*, a native from Nova Scotia to Manitoba and southward to the Gulf States, has attractive flowers above ground and many flowers which are developed underground. In general the hardy species thrive best in moist soil in low situations. The seed is sown in early spring or in autumn. In greenhouses the plants succeed well in ordinary light soil which must never be allowed to dry out. The first mentioned species may be propagated by division.

POLYGAMY, the condition of a man having more than one wife at the same time. Etymologically considered, the word would signify plurality of husbands (polyandry) as well as plurality of wives (polygyny); it is employed here in the latter (the usual) sense. Polygamy among barbarous people is customary, though among them — as indeed wherever polygamy is allowed — plurality of wives is not usual except in the upper classes. The law of monogyny (one wife), we learn from Tacitus, was most strictly observed among the Germani; "almost alone among barbarians," he says, "the Germani are content each with one wife"; yet he says that their chiefs had the right to marry several women at the same time. A custom of promiscuous marriage existed among the ancient Britons; any number of men would form a society and take an equal number of wives in common; the children born were the children of all; a like community of wives is suggested by Plato in his 'Republic.' Polygamy was allowed among the ancient Greeks, but seems to have been rarely practised. It was never customary among the ancient Romans, though no Roman law prohibited it. Mark Antony is reputed to have been the first Roman to have at once two wives; under the empire polygamous unions were not infrequent whether in the imperial house or in the class of the very rich. Laws to prohibit polygamy in the Roman state were first enacted under Theodosius and under his two sons, Honorius and Arcadius; they were abrogated by Valentinian I. The Merovingian kings of the Franks, we learn from Gregory of Tours, were polygamous, and the same author says that Charlemagne had a numerous harem of wives. Martin Luther formally approved the taking of a second wife, the first living, by the landgrave of Hesse. The Jewish laws permitted polygamy, but probably here again the practice was confined to the wealthy class. In all Christian countries polygamy is condemned by the law of the churches and prohibited by the laws of the state under penalties. In England, till the reign of James I, matrimonial questions were matters of ecclesiastical cognizance only; but under James a statute was enacted making death the penalty for polygamy. The Mormons in Utah openly professed and practised polygamy from their first settlement there till 1890 when Congress enacted drastic laws for its suppression, and it was not till after the people of Utah had constitutionally abandoned polygamy that the Territory was admitted into the Union as a State (4 Jan. 1896). Since then it is declared that the sect still adheres to its belief in the lawfulness and the meritoriousness of polygamous unions; and though they no longer openly practise it, polygamous unions among them — crypto-polygamous unions — are not rare, as is evident from the testimony before the Senate committee in March 1904. See Mormons.

POLYGLOT (Greek, *polys*, many, and *glotta*, language), a work which contains the same matter in several languages, especially a copy of the Holy Scriptures in two, three or more languages. The most important of such works is the Complutensian polyglot, prepared under the direction of Cardinal Ximenes. It was printed (1514–17), in six folio volumes, at Alcala de Henares, called in Latin *Complutum*, whence the name of the work. It contains the Hebrew text of the Old Testament, with the Vulgate, the Septuagint, a literal Latin translation, a Chaldee paraphrase (which is also accompanied by a Latin translation). Next is the polyglot of Antwerp, called the Royal Bible, because Philip II of Spain bore part of the cost of publication. It was edited by the Spanish theologian Montanus, and appeared at Antwerp in eight folio volumes (1569–72), and, besides the Hebrew text, contains the Latin Vulgate, the Septuagint (with a literal Latin translation), several Chaldaic paraphrases (Targums), also accompanied by a Latin translation, and the New Testament in the original Greek, with the Latin Vulgate, and a Syriac translation in Hebrew and Syriac letters (also with a Latin translation). Still more celebrated is the Paris polyglot, executed principally under the direction of Gui Michel le Jay, who expended his whole fortune on the undertaking. It appeared in 1645, in 10 folio volumes, and contains, in addition to the contents of the Antwerp polyglot, a Syriac and an Arabic translation (with Latin), and also the Samaritan Pentateuch (a Samaritan text, with a translation), and likewise an Arabic translation of the New Testament, with a Latin translation of the same. The London or Walton's polyglot, in 10 languages, appeared in six volumes folio, with two supplementary volumes (London 1654–57). It was conducted under the care of Bryan Walton, afterward bishop of Chester, and contains all that is in the Paris Polyglot, but with many additions and improvements, including the original text according to several copies, with an Ethiopic and a Persian translation, and the Latin versions of each. Cromwell patronized the undertaking. Bagster's Polyglot (folio, London 1831, with later editions) gives eight versions of the Old Testament and nine of the New. The term Hexapla is applied particularly to Origen's work, an edition of the Scriptures having nominally six versions in parallel columns, though in places there were nine, viz.: (1) The Hebrew text in Hebrew characters; (2) the same text in Greek characters; (3) Aquila's version; (4) that of Symmachus; (5) the Septuagint; (6) the version of Theodotion; (7, 8, 9) Greek versions of unknown authorship. Origen had also a Tetrapla, an edition of the Greek Testament in four parallel columns.

POLYGNOTUS, pŏl-ĭg-nō'tŭs, Greek painter, flourished from 450 to 410 B.C. He was a native of the Island of Thasos, and with his brother Aristophon was instructed in their art by their father Aglaophon, a famous painter of that island. Cimon, the commander and rival of Pericles, brought him to Athens on the subjugation of Thasos, and employed him to decorate the Stoa Poecile, or painted portico at Athens. Micon and Panænus assisted him in painting the Poecile. His two principal pictures there represented 'The Capture of Troy' and 'The Battle of Marathon.' In the Lesche (hall) built by the Cnidians at Delphi he painted the 'Conquest of Troy' and 'Descent of Odysseus into Hades,' which are described by Pausanias. Polygnotus is represented as being the first who gave life, motion, character and expression to the countenance, and skilful disposition to the drapery. His works are without perspective or shading, and consisted only of outlines against a colored background. Yet the nobility and fineness of his drawing and the excellence of his composition, made them justly celebrated. Pliny describes him as "the first who painted women with transparent drapery, and covered their heads with variegated caps. The first to begin to open the mouth and show the teeth of his figures, and to give them an expression of countenance different from the ancient stiffness."

POLYGON, *in geometry,* a plane figure of three or more angles and sides. A polygon of three sides is termed a *triangle;* one of four sides, a *quadrilateral* or *quadrangle;* five sides, a *pentagon;* one of six sides, a *hexagon;* one of seven sides, a *heptagon;* and similarly we have *octagon* (8), *nonagon,* or more properly *enneagon* (9), *decagon* (10), and so on. *Similar polygons* are those which have their several angles equal each to each, and the sides about corresponding angles proportional. All similar polygons are to one another as the squares of their homologous sides. If the sides are all equal and the angles are likewise all equal, the polygon is said to be regular; otherwise, it is irregular. The angle of a regular polygon of n sides is $\pi\left(1-\frac{2}{n}\right)$. Every regular polygon can be circumscribed by a circle and have a circle inscribed in it. A skew polygon is a closed figure made up of consecutive linear segments not all lying in one plane. See GEOMETRY.

POLYGON OF FORCES, a diagram used in graphic statics, depending upon the following theorem: "If any number of forces acting upon a point be represented in magnitude and direction by the sides of a polygon taken in order, they will be in equilibrium," or "any side of a polygon, taken in reverse order, will represent the magnitude and direction of the resultant of any number of forces acting upon a point, when these forces are represented in magnitude and direction by the remaining sides of the polygon taken in direct order."

POLYHALITE, a brick-red or yellowish, fibrous or massive mineral, occurring mostly in closely compacted fibrous masses. It is best known as one of the salts from Stassfurt, Germany, though it is found associated with salt, gypsum and anhydrite in other salt mines in central Europe. It is a hydrous sulphate of calcium, magnesium and potassium.

POLYHEDRON, *in geometry,* a body or solid bounded by many faces or planes. When all the faces are regular polygons similar and equal to each other the solid becomes a regular body. Only five regular solids can exist, namely, the tetrahedron, the hexahedron (or cube), the octahedron, the dodecahedron and the icosahedron, having respectively 4, 6, 8, 12 and 20 faces. In the first, third and fifth the faces are equilateral triangles; in the dodecahedron they are regular pentagons; and in the cube they are squares.

POLYHYMNIA, or **POLYMNIA** (Latin from Gr. *Πολυύμνια* or *Πολύμνια*), according to the later Greek poets the Muse of lyric song and of eloquence, daughter of Jupiter and Mnemosyne, who presided over singing and rhetoric, and was deemed the inventress of harmony, to whom is attributed the invention of the lyre and of mimes and pantomimes. The Greek artists represented her enveloped in a mantle, crowned with a wreath of flowers, and in a meditating posture. She was sometimes represented veiled in white, holding a sceptre in her left hand, and with her face raised up as if ready to harangue, or with the forefinger of her right hand on her mouth. See MUSES.

POLYMASTODON, a fossil animal found in the Eocene beds of New Mexico. In some features it resembled the rodents and was about the size of the beaver.

POLYMIGNITE, a highly complex, black mineral found in the zircon-syenite of Frederickswarn, Norway, in slender orthorhombic prisms. It is a niobate, titanate and zirconate of the cerium metals, iron and calcium.

POLYMORPHISM, *in biology,* that condition in which different kinds of individuals appear in the same species. In the animal kingdom it has its greatest exemplification in the group of Siphonophoræ, where the whole colony is made up of members, all reducible to a common type, which are specialized for the functions of floating, swimming, reproduction, eating and touch. Among the free forms it is not so common, but still is not rare. Thus among insects we find butterflies in which not only the males and females are different in their markings, but among the females different patterns may be easily recognized; in fact, so different may they be that did we not know their life-history we should not regard them as belonging to the same species. Where but two forms are known, the phenomenon is called Dimorphism. See EVOLUTION.

POLYNESIA (Greek, *polys,* many; *nēsos,* island), a geographical name applied collectively by some writers to all the Pacific islands of strictly oceanic character, i. e., either of volcanic or coralline origin; by others restricted to the vast island-dotted region extending from southeastern Asia across the Pacific, and from Bering Strait southward to the Antarctic Ocean, also called Oceania. In an ethnological sense the term applies to the eastern groups inhabited by the brown Polynesian race. A more exact method is the common division into several sections: Australasia comprises Australia, Tasmania and New Zealand, with other islands adjacent. The numerous islands extending from the Malay Peninsula to New Guinea are known collectively as Malaysia or the Malay Archipelago. The Philippine Islands are often associated with those of Malaysia proper. The name Micronesia (Greek *mikros,* small, and *nēsos*) is commonly used as a collective name for the numerous small islands in the northwestern Pacific, between New Guinea and Japan; and Melanesia (Greek *melas,* black, and *nēsos*) includes New Guinea and a chain of islands extending southeastward to the Fiji Islands and New Caledonia, all chiefly inhabited by Papuan races. All the remaining islands, comprised for the most part within the parallels of 30° N. and 30° S. latitude, and between the meridians 180° and 120° W. longitude, constitute Polynesia in the more definite sense of the term. Yet it should be remembered that although the word «Polynesia» as a collective name for these islands has been sanctioned by general custom, the title expresses a purely arbitrary division that is founded upon no geographical, national, racial or linguistic basis. Polynesia has never formed a national unit, and the name must be taken only as a convenience to express certain islands and groups of islands in the Pacific which are inhabited by people of the same stock and linguistic family, but which do not by any means comprise the entirety of this people within their limits. The following table gives a survey of the size, approximate population and political connections of the three «nesian» groups. For the sake of reference, those islands which belonged to Germany before the World War are still marked thus in the table:

GROUP	Area square miles	Population	State
POLYNESIA:			
Hawaii	6,700	250,627	U. S.
Fanning	15	200	Gt. Brit.
Ellice	14	300	"
Tokelau	12	1,000	"
Samoa	1,000	44,000	Ger. & U. S.
Tonga	450	24,000	Gt. Brit.
Kermadec	40	Uninhab'd	"
Austral	105	2,400	France
Cook (Hervey)	140	11,500	Gt. Brit.
Tahiti (Society)	600	30,000	France
Tuamotu (Low)	360	4,000	"
Marquesas	480	4,000	"
MICRONESIA:			
Marianne (Ladrone)	450	15,000	Ger. & U. S.
Pelew	200	3,000	Germany
Caroline	400	60,000	"
Marshall	160	18,000	"
Gilbert (Kingsmill)	170	30,000	Gt. Brit.
MELANESIA:			
Admiralty	770	2,000	Germany
Bougainville	5,000	20,000	"
Bismarck	16,000	188,000	Germany
D'Entrecasteaux	1,100	1,150	Gt. Brit.
Louisiade	870	2,000	"
Solomon	16,300	200,000	Ger. & Brit.
Santa Cruz	200	5,000	Gt. Brit.
Banks	190	4,500	"
New Hebrides	5,000	62,000	France & Brit.
New Caledonia	6,500	55,000	France
Loyalty	1,100	20,000	"
Fiji	8,000	140,000	Gt. Brit.

These groups of «South Sea Islands» are scattered over a hundred degrees of longitude from New Britain (149° E.) to Easter Island (109° 17′ W.) and across 70 degrees of latitude from Hawaii (23° N.) to Stewart Island at the southern extremity of New Zealand (47° 20′ S.). In this vast area of about 11,000,000 square miles of water there is hardly more than 170,000 square miles of land, of which nearly two-thirds falls to the New Zealand Archipelago, lying within the Polynesian group. The total population is perhaps under 2,000,000. Practically all the Pacific islands are now in the possession of Great Britain, France and the United States; until the World War 1914–18 some belonged to Germany. Spain at one time held extensive possessions in the Pacific; the Netherlands own the western half of New Guinea and nearly the whole of Malaysia. The islands of Polynesia proper may all be classified as volcanic or coralline, the former having an irregular surface and a higher elevation than the latter, which are low and rarely elevated above 500 feet. The atoll formation is common. Some of the smaller islands are of value only for their guano deposits. The indigenous fauna is remarkably deficient in terrestrial mammalia, the only kinds at all generally distributed being bats. The avifauna is large and interesting and several species of snakes are found in the western islands, while insects and molluscs abound in profusion. The cocoa-palm flourishes throughout all Polynesia and the sago-palm in the west. Bread-fruit, yams and the taro are staple articles of cultivation. Some of the islands, chiefly in the west, have an extensive and peculiar flora, but others, especially the more easterly, are poor in species. Though Polynesia lies almost entirely within the tropics, its climate is generally temperate and very salubrious, owing to the influence of the ocean.

The discovery of the islands began with Magellan's voyage in 1520, when he found the Ladrones, but it was not until Mendaña's expedition in 1567 that any of the large groups became known to Europeans. Mendaña also discovered the Solomon Islands. Finding gold in use among the natives, he concluded that he had found the Ophir of Scripture and named the islands after King Solomon. He made the mistake of charting them in the wrong longitude, with the result that for a long time the islands were «lost» and geographers, doubting their existence, omitted them from the maps. Mendaña himself could not find them on a second voyage in 1595, but he then discovered the Marquesas and one of the Union group. These, again, were «lost» until rediscovered in 1769 by the French navigator Surville. Quiros, formerly pilot to Mendaña, discovered Tahiti and the northern of the New Hebrides in 1606. Ten years later, Schouten and Le Maire, Dutch navigators, discovered the most northerly islands of the Tonga group and several small Polynesian atolls, but they missed the main groups of Tonga and Fiji. These were left for Tasman (q.v.) to find some 26 years later. Van Diemen, the Dutch governor at Batavia, sent out an expedition under Tasman in 1642 with momentous results, for not only were the remainder of the Tonga and Fiji groups discovered, besides numerous other islands, but also New Zealand, Tasmania and the great continent of Australia. French and English navigators led in discoveries during the 18th century. Wallis discovered the island that now bears his name in 1767 and De Bougainville discovered the Louisiades and the main islands of the Samoan group in 1768. The British geographer, Dalrymple (1737–1808), concluded that there must be a vast southern continent stretching from Australia to the South Pole. To test this theory Captain Cook's famous expedition was sent out by the admiralty in 1772. Though he naturally failed to find the continent which did not exist, Cook discovered the Raratongan group (Cook's Islands), Savage Island, the Loyalty Islands and the Sandwich group (Hawaii), though it appears from native tradition that a shipwrecked

European crew had been washed ashore at Hawaii some 50 years before. The French government despatched two frigates in 1785 under the command of the Count de la Pérouse (q.v.) to pursue scientific discovery in the South Seas. On 26 Jan. 1788 La Pérouse entered Botany Bay and handed the English governor there a package of papers to be sent to France. He set sail again on 15 March, after which the two vessels were lost to human ken. The papers duly reached their destination; the National Assembly published them and sent a naval expedition under D'Entrecasteaux to search for La Pérouse and his ships. On this voyage the D'Entrecasteaux group of islands on the eastern extremity of New Guinea were discovered. Forty years after the disappearance of La Pérouse an Irishman, Peter Dillon, landed at Vanikoro, an island of the Santa Cruz group, and found the relics of the La Pérouse expedition — but no survivors. D'Entrecasteaux might have found and saved them had he sailed further south. The last had died three years before Dillon's visit.

At the dawn of the 19th century Europeans were living on most of the large islands, mainly deserters from passing ships. The London Missionary Society sent out a number of artisan missionaries in 1799 to Tonga, Tahiti and the Marquesas. The mission to Tahiti flourished; the two others were subsequently abandoned. About that time whaling-ships began to frequent the South Seas and from this era dates the real colonization of the islands by white men. Unfortunately, however, the frequent deserters from the crews of these vessels were not a desirable type of settlers, so that the natives acquired their first knowledge of Europeans from the worst specimens of the race. A stream of real immigration began about 1850 through the influx of white traders and planters. The 16th century of Polynesian history belongs to the Spaniards; the 17th to the Dutch; the 18th to the English, and the 19th to the traders, whalers and missionaries of all nations. See MAORIS; MELANESIA; MICRONESIA; MYTHOLOGY, and the islands under their separate heads; also POLYNESIANS.

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POLYNESIANS. Many studies have been devoted to the origin and migration of the Polynesian people. It has been maintained, largely upon undigested linguistic material, that they are of the Aryan race; with equal insistence certain other students on the same linguistic ground have assigned them to such intimate association with the Malay people as to predicate a Malayo-Polynesian race. Our real knowledge of the Polynesian people dates from their discovery by the great navigators in the islands of the Pacific which they now occupy. By legitimate interpretation of, and inference from, the very considerable body of Polynesian traditions, which have been collected, we may reason the past history of the Polynesian race back to its occupation of the islands now known as Indonesia, and at present occupied by Malayan peoples. Anterior to their residence at a remote epoch in Sumatra, which is abundantly confirmed by the persistence of a distinctly Polynesian strain in the Mentawei Islands, which lie off-shore along its western coast, we are lacking in data whereupon to predicate an earlier history of this race. Percy Smith, in 'Hawaiki,' proposes the identification of their ancestral home in the valley of the Ganges; dissection of certain of the linguistic material seems to suggest with equal plausibility an earlier home in conditions which most closely correspond to those of the Hadramaut of southern Arabia in the present day. With our present material the matter seems incapable of solution. Assuming, then, as susceptible of satisfactory establishment, their former residence in certain of the larger islands between Sumatra and the Philippines, we can picture to ourselves a race of people on a plane of culture which may fairly be classed as neolithic, that is to say, in possession of wooden and polished stone implements which could serve for offense or defense, according as the daily need arose. It is also clear that they were in possession of the arts of navigation to a very satisfactory extent. Upon people of this cultural plane broke in an irruption of a race of higher culture as shown by the possession of weapons of mild steel. In the datable chronology of Hindustan, this irruption may be established as the entrance of Malayan ancestors into Sumatra 400 years B.C. The possession of the superior weapon of offense meant the extermination of the club-armed Polynesian ancestors or their migration in search of a safer home, and their possession of canoes and their knowledge of how to ply the sea, led to the adoption of the latter alternative. It now becomes incumbent to examine the postulate of a Malayo-Polynesian race. This was proposed by Bopp in the second quarter of the last century, entirely upon linguistic grounds. It has been possible to collect the material which he was able to have under study and to determine that while the accessible material was sufficient to enable him to make an intelligent study of Malayan languages, the material at that time in existence pertaining to Polynesian languages was so scanty in extent and so poor in quality as to render his results entirely unworthy of credence. There remains, however, a certain speech community of Malayan and Polynesian; this amounts to little more than 250 words and the modern explanation of this community is that these words are Polynesian, which became incorporated in Malayan as loan material derived from their captives at the period of the great expulsion from Indonesia. Physically the Polynesians are one of the most attractive of the human race and are marked by a stature which, with the doubtful exception of certain Patagonian peoples, represents the highest growth of humanity. With some interesting traces of the matriarchate, Polynesian society is rather genetic than political. Each family exists as a social unit, holding all its goods in common, the chief is the family head, who is selected by common agreement from the members of that family and it is not uncommon to find the position of chief thus held by women; in general, there is no priestly class, but the functions whereby intercourse is had with the departed who have become family gods are exercised by the chief as priest. There is a wide distinction among the gods, the higher gods are self-existent, their sole activity the original creation of this world and its inhabitants, indifferent to the course of current events and not to be moved by prayer; the lesser gods are spirits which have already undergone a human existence and may, therefore, be the object of supplication, as possessing a certain sympathy with the affairs of mankind. In the highest degree the religion of the Polynesians has no connection with ethics, the moral sense and the doctrine of punishments being entirely dependent upon the tabu. The tabu is a moral prohibition; in its greater sense it may be considered as an unknown foundation of social life, in its minor sense it may be imposed for temporary and temporal uses by any person in possession of authority over the object with which the tabu is associated. The tabu is self-executive, its violation provides its own punishment and in the sensitive conscience of the Polynesian this punishment is not to be evaded. It has been found possible to establish a beginning date of the Polynesian migrations as fixed by the Malayan irruption under Aristan Shar in 400 B.C. Detailed study of Polynesian traditions makes it plain that there were two ways of migration. The earlier, that to which the name Proto-Samoan has been applied, appears to have reached the Central Pacific, that is, Samoa, Tonga and Fiji, about the Christian era. Upon this first settlement there swept a second wave of migration, that which by the Samoans is called the Tongafiti, some 600 years later. The Tongafiti were in possession of a decided advance in the arts of life and were able to rule the Proto-Samoans as a subject people for several centuries; finally, at a period very nearly contemporaneous with the Norman conquest of England, the Proto-Samoans were able to throw off the yoke of the oppressor and then began the second era of migrations in the Pacific, whereby the Tongafiti, with more or less Proto-Samoan companionship, advanced to the settlement of the more remote islands from Samoa as a distributing point. It has been possible to establish this duality of the Polynesian migration waves by a philological examination of the different Polynesian languages. This diversity is also found in the scheme of the god-head. The Proto-Samoans recognize one god, Tangaloa, the creator, held in reverence but not the object of prayer nor of sacrifice; the Tongafiti had arrived at a conception of four great gods. Tu, Rongo, Tane and Tangaloa, of whom the last was reduced to a position of small relative importance. The Tongafiti centred all their worship of the great gods in the act of human sacrifice. In certain of their branches they had arrived at the Messiah idea of a god who should return to bring blessing to his people; the vanished god was Rongo, and it was an offshoot from the belief that Captain Cook was Rongo, returning for the salvation of his people, that led to the death of that great navigator at Kealakekua, in Hawaii. The first result of the contact of European civilization with these happy islanders was deplorable, for to a people who had not acquired constitutional immunity the simplest ailments of our life, coughs and measles, led to a rapid increase of the death rate. For many years the population of Polynesia seemed to be progressing rapidly toward extinction, but in the present century, the records show an upward turn, and it is probable that the race will be able to adjust itself to the new conditions. In general the Polynesians have made but a superficial advance in the new culture, but in Hawaii, and among the Maori of New Zealand it has been abundantly established that they are capable of taking a position quite on an even plane with the British and Americans with whom they are associated. Much has been written upon the Polynesian race regarded as elements of a political problem, or as a social problem. As bearing upon their ethnic position, the principal works of reference are the *Journal of the Polynesian Society* (New Plymouth, New Zealand, current), Smith, S. Percy, 'Hawaiki' (Wellington, New Zealand 1910); Churchill 'The Polynesian Wanderings' (Carnegie Institution, Washington 1911); Dixon, Roland, 'Mythology of all Races: Oceanic' (Boston 1916). See also Polynesia; Bibliography.

William Churchill,
Author of 'Polynesian Wanderings,' etc.

POLYNICES, pŏl-ĭ-nī'sēz, brother of Eteocles. See Eteocles and Polynices.

POLYOLBION, pŏl'ĭ-ŏl'bĭ-an, The, a long descriptive poem (1613–22), by Michael Drayton. It is in effect a topographical survey of Great Britain, containing, with much other matter, descriptions of shires, rivers, mountains and forest tracts, and is not only of interest to the antiquarian, but to others as well, its accuracy as an authority being generally conceded.

POLYP, a term variously and indiscriminately applied to different animal forms, but properly designates a cœlenterate of the class Actinozoa, represented by the sea anemones, corals and the like, or any member (or zoöid) of a compound organism belonging to that class. The term *polypide* is also employed to designate each member or zoöid of the compound forms in the Polyzoa. The name *Polypidom* applies to the entire outer framework or skin-system of a compound form, such as a hydrozoan, zoophyte or an individual polyzoön. The word *polypite* refers to each separate zoöid or member of a compound zoophyte or hydrozoön, and is thus used in opposition to the term *polypide* already explained. The *polypary* of a hydrozoön specially refers to the horny or chitinous skin secreted by the hydrozoa. See Cœlenterata; Hydrozoa; Mollusca; Polyzoa, etc.

POLYPHASE SYSTEM. See Electrical Terms.

POLYPHEMUS, pŏl-ĭ-fē'mŭs, one of the Sicilian Cyclopes. He was a son of Poseidon and the nymph Thoösa and lived in a cave in Mount Ætna. Ulysses and his companions, driven by the storm to take refuge on the island, found shelter in the cave of Polyphemus and were found there on the return of the monster. He devoured two of the company and shut the remainder in the cave. Ulysses contrived to intoxicate Polyphemus with wine and when he fell asleep put out his single eye and then with his comrades escaped. The storms which followed Ulysses at sea were visited upon him by Poseidon in answer to the prayers of Polyphemus. Polyphemus was a suitor of the nymph Galatea and upon her accepting Acis the disdained lover killed his successful rival. In zoology the term is applied to a genus of Ostracoda, having a large head almost entirely occupied by an enormous eye.

POLYPHEMUS MOTH, a large American silk moth (*Telea olyphemus*) of a yellow-brown color, with spotted wings. The caterpillar is of a light-green color with yellow markings; the cocoon is oval and is generally enclosed in foliage.

POLYPHONY, *in musical composition*, the harmonious combination of two or more parts, each of which forms an independent theme, but progress simultaneously according to the laws of counterpoint. A fugue is the best example of polyphonic compositions. See Counterpoint.

POLYPODIUM, a genus of ferns of the family *Polypodiaceæ*. The species, of which more than 350 have been described, are widely distributed throughout the world, mostly in dry situations such as banks, walls, logs and cliffs. Some tropical species are epiphytic. Many are popular as garden or greenhouse plants. Among the best known is the common wall-fern or polypody (*P. vulgare*), a widely distributed native of Europe and North America. It is one of the most satisfactory garden ferns. See Fern and Fern Allies.

POLYPORUS, a genus of parasitical fungi, forming shelf-like growths on the trunks of trees and contributing to the decav of timber. It is the typical genus of *Polyporaceæ*. See Fungi.

POLYPTERUS, a genus of ganoid fishes of a single species, *Polypterus bichir*, inhabiting the Nile, Senegal and other rivers of Africa. It attains a length of about four feet and lives in the mud at the bottom of rivers, where it crawls by means of its fins. It is capable of swimming with great rapidity. See Bichir; Ichthyology; Mud-fish.

POLYPUS, *in pathology*, any tumor which forms chiefly in a mucous membrane, and which is more or less pedunculated and rounded in form. (See Tumor). In zoology a class of radiated animals having many prehensile organs radiating from around the mouth only.

POLYTECHNIC COLLEGE, an institution of higher learning, located at Fort Worth, Tex. It was changed from a coeducational institution to Texas Woman's College (devoted exclusively to the education of women) in September 1914. The bachelor of arts is offered, the bachelor of science being discontinued, effective June 1915. In connection with the college are the school of fine arts, school of household economics and the academy. The commercial course has been discontinued. Buildings and grounds are valued at $300,000. The faculty numbers 40 and the average enrolment is in excess of 300 students.

POLYTECHNIC INSTITUTE OF BROOKLYN, founded in 1854 under the name of the Brooklyn Collegiate and Polytechnic Institute. It conferred its first collegiate degree in 1871 by special authority of the State board of regents; and in 1890 was reorganized under its present name with larger corporate powers and a full college charter. The institute now offers four undergraduate courses of four years: (1) chemistry, leading to the degree of B.S.; (2) civil engineering, leading to the degree of C.E.; (3) electrical engineering, leading to the degree of E.E.; (4) mechanical engineering, leading to the degree of M.E.; (5) chemical engineering, a five-year course leading to the degree of chemical engineer; also graduate courses of one year; science, in the department of civil, electrical and mechanical engineering, leading to the degree of M.S. The laboratories are well equipped, and there is an observatory with an equatorial telescope, and museum collections in geology, zoology and palæontology; the library, a memorial to Uriah D. Spicer, numbers 12,000 volumes. The preparatory school is closely affiliated with the institute, and is not only designed to prepare students for the institute, but also prepares them for other colleges and scientific schools. The students, including those in the preparatory school, numbered more than 1,200 in 1918. The institute is one of the oldest educational institutions of Brooklyn, and counts among its graduates many of the most influential men of the city.

POLYTECHNIC SCHOOLS. See EDUCATION, SCIENTIFIC AND TECHNICAL.

POLYTECHNIQUE, originally a French educational institution in which the technical sciences that rest in great part upon a mathematical basis, such as engineering, architecture, etc., are taught. The first school of the kind was established in Paris (1794) by the National Convention, under the name of School of Public Works. No students were admitted but those who intended to enter the public service, especially the corps of civil and military engineers and the artillery. The Polytechnic School, as it was called from 1795, has been repeatedly reorganized as the different political parties have succeeded to power. At the present time it is the institute in which France trains her artillery and engineer officers, her naval engineers, her directors of roads and bridges and of mines, her telegraph officers, in short, all her officials who require to know something of the higher branches of technical science. The Minister of War exercises supervision over the school. The degree of bachelor of arts is a prerequisite for admission to the entrance examinations. The course extends over two years and successful graduates after the final examinations elect the special branch of the public service to which they wish to attach themselves. Soldiers in service are admitted to the Polytechnique under special conditions.

POLYTHEISM, *in sophiology,* or the science of human conceptions, term employed to designate the doctrines peculiar to the ontologies of most mythological philosophy of a plurality of gods, as well as the primitive theories of knowledge out of which such doctrines proceeded. Polytheism, thus characteristic of an ontological doctrine, designates in particular all theologies which are part and parcel of an exceedingly primitive world-conception. The most obvious task in sophiology in this connection is to restate the definition of a concept, an idea; and then briefly to lay open the common character inherent in the idea of a god, the idea of a polytheon and the idea of God. And it is equally obvious that to find such common characteristics, modern prepossessions must be set on one side: we must boldly enquire: What is the minimum definition of God?

Before proceeding to these definitions let us review the situation under polytheism as a whole. For the purposes of study, sophiologists conceive of three very general phases in the development of human thinking. Distinguishing these according to the methodology peculiar to each of these phases, they have characterized human philosophies as mythological, metaphysical and critical. As every philosophy implies at least an embryo-ontology, so have we characterized the doctrine of many gods, or of a polytheon, as the theological portion of mythological ontology. For, in truth, mythology is not religion; it is primitive philosophy or science. It is religious in so far as it is theological science. And, of course, as theological it is philosophy or science of a sort that owes its origin to the existence of religious experience in the heart of man. The simplest savage who wonders at the unseen but mighty wind that streams from unknown realms of power has already felt that which abides unchangeably amid the flux of the phenomenal world; has already felt that which inspires religious feeling and its volitional consequents, cults and philosophically formulated theologies, such as polytheism. For religion is essential humanity. The wild beast to escape the storm shrinks growling into the cavern called its den. But on the same occasion the most abject human savage, awe-stricken, turns, falls and prays. The lowest man perceives a hand behind the lightning. He hears a voice abroad upon the storm, and for both these things the highest brute has neither eye nor ear. Nor is even an atheist without religious experience, unless he is inhuman. For there can be little doubt that there are at present those who are atheists only in this sense, that they merely deny every particular theism on the ground that it is an *inadequate* expression of the whole mystery of being. Now that can be no profound thinker who is without any sympathy for such a position. Again: to deny our need of religion is one thing; to deny its existence altogether in the human heart is quite another. Schleiermucher stood upon a rock when he asserted the self-authentication of the religious consciousness. For the variations among theologies, polytheistic, herotheistic or monotheistic (which are philosophies), can no more affect the experiences which constitute and succeed the spiritual new birth of anyone, than the variations among biologists can affect one's assurance that he is alive. Yet as some there be who have an atrophied intellectual consciousness, and are idiotic; so some, too, it may be granted there may be who have an atrophied spiritual sense and are inhuman. But if any possess a religious mythological philosophy, or theology, we may be quite certain that they likewise share the religious experiences. In this way even polytheism expresses the religious life of man.

Religion then, in a polytheist even, is not the intellectual formulation, in the shape of dogma, or doctrine, of mankind's conscious relation to God, a relation which all feel. Such formulation on the contrary is the work of philosophers. Principles thought to be discovered of man's relationship to the ultimate grounds of being are gathered and made into a group, a «science»; and the cultivation of this «science, or mythic system becomes, in primitive culture periods, the duty of a special class. This class is that of the priest, shamans, rab-mags, bikshus, magicians or wabeno-men. All are primitive philosophers. Thus we come to the idea of religion in the widest sense, as the perception of the supernal world together with the effects of that perception on the complex nature of man; while theology, in a way commensurate with this idea of religion, is understood as that perception and its consequences reduced to system however crude. Examples of such theologies are still extant; some systems are now building. The earliest systems are the mythical systems of polytheism which originated under influences of the experience of our most remote ancestors.

What meaning had his surroundings to primæval man when eye and ear could be directed from the prior claims of the body? (See MYTHOLOGY). In his first outlook upon the world man was altogether ignorant of the character of nature's real powers by which from the very beginnings of human life he was circum-environed. Poorly endowed with reason and blunt of sense-perception, he beholds the cold wave sweep from the north; and rivers and lakes he sees freeze over. Great forests are buried under a white mantle of snows. Piercing winds almost congeal the very life-fluids of man himself; while his source of food — the lakes and streams — lie strongly encased in a carapace of ice. Another time the sky assumes the dull appearance of a dome of brass. Midsummer heat pours down its beams upon the sands; and fiery blasts heated in a desert furnace destroy a scanty vegetation. And the fruits of the earth shrivel before the eyes of famishing men. Consider but one passage from the Bible, one originating in comparatively civilized times, under an experience, as when the voice of Jehovah sounded amidst the bursting forth of a mighty natural convulsion: «A thick cloud was upon the mount. The smoke thereof ascended as the smoke of a furnace. There were thunders and lightnings. And the voice of the trumpet exceeding loud. The Lord descended upon the mountain in fire, and the mountain quaked greatly.»

This word-pitcure comes from Exodus. It details, we think, a gigantic volcanic eruption. Mount Sinai was a volcano. How much more terrifying must have been the grandeur incident to such an experience in the soul of a poor, half-clad savage during the progress of a similar event? He stands nearby while lightning shivers a great tree and rends the skull of his companion. To a savage all nature's powers bring pain or joy, health or sickness, life or death. His well-being is involved in the answer he gives to his questions how? and why? No wonder then if at first man's attitude of awe degenerates into slavish fear, when he presumed to confront the worlds and question them. And yet withal we find that throughout the whole mythologic period of «science,» man's sole measure of things was himself.

History in so far as it affects the inner life does not exhibit one continuous ascent. It reveals not alone rise and growth of creative effort in the philosophic field but likewise ensuing periods of exhaustion. It is in this way that it comes about that one finds recurring periods during which the human spirit manifests itself in tradition-guided behavior alone rather than in aspiration after philosophic formulation of its cosmic relations. It is only when again the human spirit retires into itself to take deeper root that new relations are perceived which need expression and explanation.

Even for the period, that of mythological philosophy, this is true. And as a consequence one may easily discriminate four phases of polytheistic thought. In one, perhaps this represents the earliest phase, everything presented to the savage mind is conceived of as alive.

An «orenda» or living magic power inheres in everything; every object is possessed of will and design. Rocks, trees, animals and men think and speak-so the earliest philosophers testify in their earliest myths. All the bright stars of heaven, the snow-clad mountains, bubbling springs, rivers, all are possessed of will and design. In this stage, every insoluble event and object is a god.

Thereupon follows a period when the savage philosopher no longer attributes life indiscriminately to all inanimate nature. But all the powers and attributes recognized in self-examination he transfers, attributing them to animals. Nowhere is the line drawn between man and beast. Men are zootheists, they worship beasts. And all the gods are animals. Zootheism persisted down to comparatively recent times. What but representatives of these gods are the gigantic zoomorphs in Yucatan and the animal-headed gods of Egypt and Assyria? And indeed there was even a scaly fellow in Paradise! Survivals of the time when all the gods were animals, and all natural processes were the doings of animal gods, are not difficult to find in mythologies.

In a third period a gulf is placed between man and all the lower animals. Animal gods are either dethroned or assume a subordinate station. Thereupon all nature's powers, all phenomena, are deified; and in the deification, anthropomorphized also. It is during this period that man worships the gods of the sun, moon, air, dawn, a deity of the darkness or one of night. Anthropomorphism is *not* absent from the Bible. In Genesis we find God walking about the Garden of Eden. With His own hands He fashions man and closes the door of the ark. He even breaths his own breath into man's nostrils, and makes *unsuccessful* experiments with animals! He scents the sacrifice of Noah. And, Othin-like, appears to Abraham and Lot in the guise of a wayfarer; or, as an angel calls directly out of heaven, God, in Genesis, verily speaks in all respects as does one man to another!

Finally a fourth, the highest, period of primitive philosophy is reached. During it, mental, moral and societal characteristics are personified, and thereupon deified. Thus was born the idea of a god of war, a god of love, a god of revelry, a god of plenty. These gods differ from all older nature gods chiefly in that they possess distinctively psychical characteristics. Many of them are among the first "moral" gods.

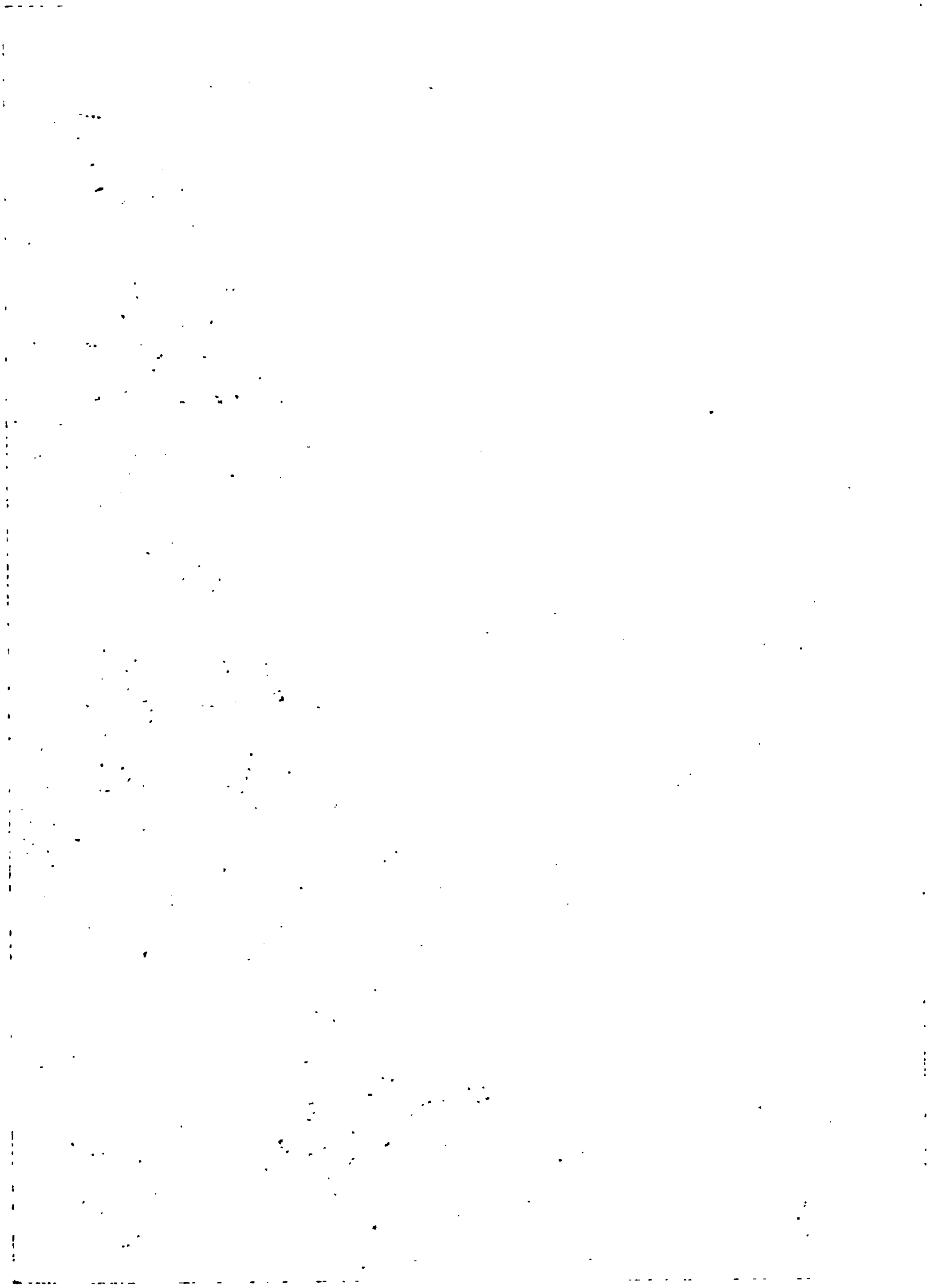
Religious conceptions, "theologies," thus comprehend above all that group of concepts which spring from man's relations to the supernal world; and this relation is of course always considered by philosophically inclined savages as not due to any physical activity merely, for all such activities or natural processes, they would naturally account for with purely rationalistic conceptions, as a matter of course. It is plain, therefore, that as man's knowledge of nature's laws widens, the domain of his supernal world shrinks in proportion. Theologies are always attempts to formulate just those truths considered necessary in man's struggle for existence. Of such theological opinions, ideas or conceptions, that of the gods, and the idea of God, remain even to this day the most important thoughts in human life. In all humanity, as well the lowest as the highest, there is an effort of some kind to express in doctrine man's conscious relation to the abiding in the transitory of the world. Such consciousness of a higher power is necessarily given when first the simple savage comes to such a stage of maturity that the fragmentariness of his creature life is contrasted instinctively with that in which he lives, and moves, and has his being. Thus conscious of a being more powerful, more abiding, greater than himself, man is constrained to establish some idea of that to which he must always submit. Hence arose those doctrines embodied in all polytheons, all pantheons, all aspirations to become one with God.

What is the minimum definition of God? A polytheon, a pantheon, or even the idea of God is always a world conception that dominates man's soul. In all polytheistic stages of belief, however, not all gods, even some of the higher orders, are necessarily objects of devotion. For there are in some polytheons, faineant deities, deities who are recognized as real but who do not exercise any influence in human affairs. Hence they are not worshipped. We are now prepared to understand a conception, and in particular that conception which at a minimum content conveys the idea of a polytheon, a pantheon, a god, or even of God. The definition of an idea, in particular a religious idea, and when it is familiar, even of its name, is an impulse to some activity, the usually sense-perceptive result of which is a term or member of the concept's scope. Now the word polytheism conveys the idea of many gods, monotheism signifies belief in God. What is common to both the nature of the idea of a polytheon, and the idea of God?

We understand by the nature of an idea its meaning. Now each and every creature properly human has to respect some higher power, a power that curtails his wishes. And each and every human being, therefore, adjusts himself to conditions; and so doing recognizes an authority of some kind to which he must submit on all occasions; and this authority of man's conduct, whatever it may be, is either his polytheon, his pantheon, his god or God. The mention of this authority even is an impulse to religious behavior. Its moral significance is without question. For even the (to us) immoral practices of savage and semi-civilized peoples prove that religion and morality, while distinct, are yet inseparable. A superstitious awe of a polytheon, yea even of God, leads to immoral practices. And in this way also a pure religion will unfailingly regenerate whoever possesses it.

But does it not make a difference whether or not the truth of the conception is mentioned in the definition of God? Maybe it does. For what do we mean by truth in this connection? In effect what one ought to mean by the truth or falsehood of the doctrine of deity is not the reality or otherwise of any events which are associated with its rise; but, on the contrary, the adequacy of the idea to inspire just such feelings and to constrain to just such religious behavior as will give expression to a believer's conscious relation to the ultimate grounds of existence, the abiding, in the measure that he *knows them*. And we are led to a second consideration in this connection. The late association of moral ideas with deity proves also to have been a fact. True ethical considerations were originally foreign to ideas of deity. In the first three stages of mythology, of the four phases mentioned above, all gods are neutral in so far as ethical qualities are concerned. Sacred awe too easily degenerates into slavish fear in the savage heart. The lowly beginnings of theology are strangely unlike its fruition. Only after having anthropomorphized the deities of his polytheon did man conceive of his gods as moral beings. For man, as a rational animal, alone is moral. Conceiving of his gods as possessing a human form, and in the days when ideas of kinship were first gaining clear recognition, early man transferred his own qualities, societal and moral, to his gods. Thus too, contrary to what Mr. Spencer says, ancestor worship was not primordial, but late, owing to the late recognition of the ties of kinships. Gods in the polytheons of the anthropomorphic age are thus usually revealed in the mythologies which have survived as organized into a tribe or other social groups. Thus arose the kinship features in all the higher mythologies, those of Vedic India and pre-Zarathustrian Iran, the polytheons of Semnites, Assyrians, Babylonians, Egyptians, Greeks, Romans, Chinese and Japanese, as well as in those of the Aztecs, Mayas, Peruvians, and in those of the natives of the Polynesian isles.

In the opinion of Jacob Grimm, polytheism almost everywhere arose in innocent unconsciousness. There is about it something soft and agreeable to one's feelings. It is never intolerant of other gods. Yet when the intelligence is roused a polytheist will revert back to the monotheism from which his faith started. Proto-historic precursors of the prophets read the signs of the weather in the skies, and their still prehistoric successors read the Will of God in their own hearts, and became priests and shamans, wabeno-men and rab-mags, untold ages before the first hieroglyph appeared carved on an Egyptian tomb or monolith. In sublime egotism the primitive philosopher of early times interpreted nature and nature's God as an extension of himself. Dream life was to him revelation. And, indeed, to say that God spoke to one in a dream, is that not to say that



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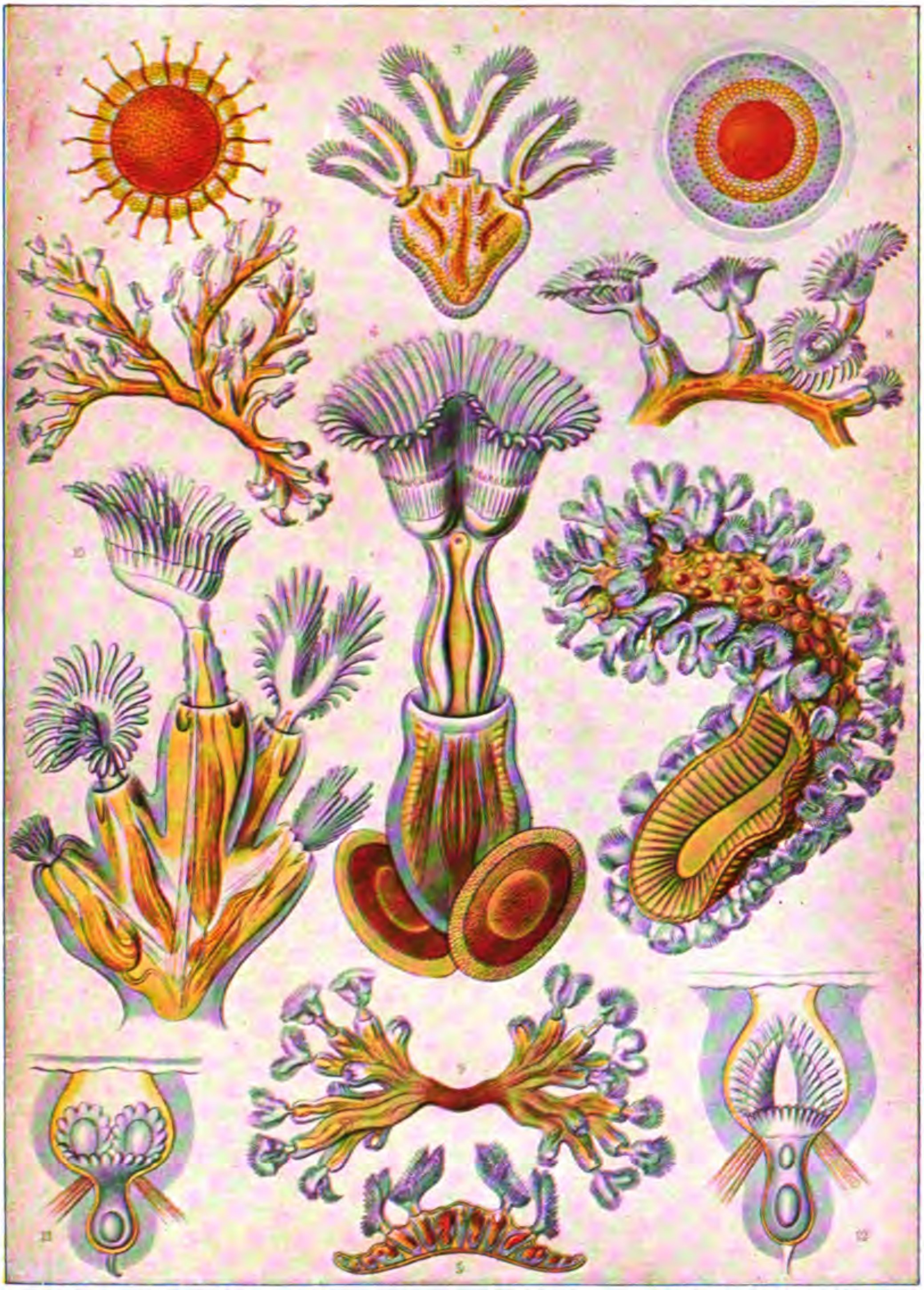
POLYZOA



1-5. Cristatella mucedo (1, a statoblast; 2, another, more advanced; 3, a young stock or cormidium; 4, fully formed stock or cormus; 5, cross-section of Fig. 4). 6-8. Plumatella repens (6, young individual; 7, young stock; 8, a portion of Fig. 7 enlarged). 10-12. Lophopus crystallinus (10 a young stock; 11, young bud not yet opened; 12, another bud, more advanced, but not open.).

one dreamed that God spoke to one? Soon a personal life was attributed to the sun, the moon, clouds, rivers, seas, oceans and the very trees. Some spiteful demon rooted the latter to the ground! The ever-varying phenomena of the sky, at dawn, at noon and at even-tide — many were the deities of men. All this be it remembered was not pretty invention, allegory or poetic conceit! The primitive philosophic theologian was no embryon Cabalist, no conscious fabler. On the contrary he and his disciples entertained the idea of a polytheon as their highest wisdom. He meant speaking of his gods, precisely what he said. Monotheism did not succeed polytheism. Nor did the latter succeed monotheism. They are twins, born together. For whenever the early thinker, at rare moments, though deeply and felt clearly he must have experienced, however feebly, or even grossly, the presence of an ever-abiding mystery pressing for interpretation. We have thus monotheism, in truth, throughout all ages, not in genuine conflict to polytheism in the inner life nor yet clear to thought; but potentially, in living intuition in the religious sentiment. Truly, it may be said of Him, He is not far from any of us.

POLYXENA, pŏ-lĭk'sĕ-nạ, in Greek legend, the daughter of Priam and Hecuba. She was beloved by Achilles, who in order to obtain her for his wife promised to bring about peace between the Greeks and Trojans. While negotiating the marriage at the temple of the Thrymbræan Apollo, Achilles was treacherously slain. Afterward his shade appeared demanding Polyxena and she was, therefore, sacrificed to his Manes. Her sacrifice is represented in the Acropolis at Athens and forms a part of the ‘Hecuba’ of Euripides.

POLYZOA, a group of animals, at first regarded as radiates, then as mollusks and later as members of the heterogeneous group of worms. Its precise rank and position remain to be determined. All are small and all are aquatic, the great majority being marine. At the anterior end of the body is a circle of ciliated tentacles around the mouth. By means of these food is collected and brought to the alimentary canal. The intestine is flexed on itself and the vent is on the dorsal surface, either near the tentacles (*Ectoprocta*) or inside the circle (*Entoprocta*) while the central nervous system lies between the mouth and vent. In the *Entoprocta* the body-wall is solid, but in the *Ectoprocta* there is a spacious body cavity (cœlom). Besides reproduction by eggs all multiply by budding, the result being the formation of colonies, often of considerable extent. The *Entoprocta*, the characters of which are included above, embrace only a few forms, each individual being raised on a slender stalk, the colony being connected by a running rootstalk on the support to which the animals are attached. *Urnatilla gracilis* occurs in the fresh waters of the United States. Most of the species are marine.

The *Ectoprocta* secrete a protective case, often rendered firmer by the deposition of lime around each individual, and into which the animal may quickly retreat, the opening in some cases being closed by a door or operculum. The great majority of the *Ectoprocta* belong to a group called *Gymnolæmata*, in which the tentacles are in a more or less perfect circle. All but a few of them are marine, and are among the most abundant of animals along our whole coasts, some forming encrusting sheets on shells and stones, others forming bushy growths on rock and piles. The *Phylactolæmata* are exclusively inhabitants of fresh water, and are characterized by having the tentacles folded into a horseshoe shape. In these, as in sponges, there is the formation of peculiar buds (statoblasts) enclosed in a hard shell which preserve the species through the winter or in times of drought.

The closest allies of the *Polyzoa* (which are also known as *Bryozoa*, so named by Ehrenberg and accepted by J. W. Thompson) are the *Brachiopoda*, the two groups having formerly been united as a class *Molluscoida*. H. Milne-Edwards united the *Polyzoa, Brachiopoda* and *Tunicata* in his group *Molluscoida*; but it has been since shown that the latter belong to the *Vertebrata*, and the relation of the first two rested on a mistaken identification of parts. The *Polyzoa* are also related to the *Phoronididæ*, which in turn show resemblances to the *Annulata*. Consequently the three groups have been united as classes in the phylum *Molluscoida* by Parker and Haswell, ‘Text-book of Zoölogy’ (1897).

POMACE FLY, a small yellowish fly of the genus *Drosophila*, frequently a nuisance in cider factories and wine houses. The eggs are laid in the pomace in which the larvæ feed and from which the adults fly to the houses. They also visit dwellings in which decaying fruit is exposed. Sometimes they breed in other organic remains. Cleanliness and the prompt removal of fermenting or decaying matter are preventive measures.

POMADE, POMMADE, or **POMATUM**, a term originally applied to a fragrant ointment prepared with lard and apples, but now wholly restricted to perfumed solid greasy substances used in dressing the hair. In the preparation of pomades the first object of consideration is to obtain their fatty basis in as pure and fresh a state as possible. Lard, beef and mutton suet, beef marrow, veal fat and bear's grease are the materials commonly employed for this purpose, either singly or in mixtures of two or more of them. The fat, which should be that of a young and healthy animal, is pounded in a marble mortar in the cold, until all the membranes are completely torn asunder; it is then submitted to the heat of a steam-bath until its fatty portion has liquified and the albuminous and aqueous matter and other foreign substances have completely subsided. The liquid fat is then carefully skimmed and passed through a flannel filter. In this state it may be perfumed at will; after which, when it is intended that the pomade should be white, it must be constantly stirred with a glass or wooden spatula until it solidifies; should it be wished transparent or crystalline it is allowed to cool very slowly without being disturbed. To prevent its becoming rancid a little benzoic acid, gum benzoin or nitric ether may be added and to increase its consistency a little wax or spermaceti. Pomade may be perfumed by enfleurage, maceration or simply by adding the fragrant essences or essential oils in the required quantity. See PERFUMES AND PERFUMERY.

POMBAL, Sebastião José de Carvalho e Mello, sā-bās-tē-än'oo hō-sā' dā kär-väl'yoo ā mā'loo pôṅ-bäl', or pŏm-bäl', Marquis of, Portuguese statesman: b. Soura, near Coimbra, 13 May 1699; d. Pombal, 2 May 1782. He successively entered the law and the army, but soon relinquished each because of incompatibility. In 1739 he was appointed Ambassador to London, but was recalled in 1745. He was then sent to Vienna to act as mediator between the Pope and the Empress Maria Theresa. Carvalho here gained general esteem and married the youthful Countess of Daun. In 1750 Carvalho obtained from Joseph I the post of Secretary of State for Foreign Affairs and soon rendered the feeble and sensual king entirely subject to his influence. Joseph I fell in with the most daring projects of his minister; and the latter now proceeded to the accomplishment of his four favorite objects — the expulsion of the Jesuits, the humiliation of the greater nobles, the restoration of the prosperity of Portugal and the absolute command of the state in the name of the monarch. After the earthquake of 1 Nov. 1755, which destroyed Lisbon, Carvalho displayed great vigor and resolution. He was now created Count of Oeyras and in 1756 First Minister. He then removed every one who ventured to obstruct his plans. The discontented vinedressers committed excesses in Oporto, but Pombal vigorously suppressed the riots and passed most comprehensive laws against treason. He also expelled the Jesuits from their flourishing missions in Paraguay. Carvalho finally determined to remove the Jesuits entirely from the person of the king and they were ordered (16 Sept. 1757) to retire to their colleges. A conspiracy against the life of the king, who was wounded on the night of 3 Sept. 1758, by assassins, he falsely laid to the charge of the Jesuits. Pombal denounced the Jesuits to the Pope as the contrivers of the scheme and caused some of them to be executed in prison. Pombal had already banished the whole order from the kingdom by a royal decree of 3 Sept. 1759 and those who did not comply with the mandate were seized and transported to the states of the Church. A protracted dispute with the Pope followed; in 1760 Pombal transported the papal nuncio beyond the frontiers and was on the point of dissolving all connection with Rome when Clement XIII died and Clement XIV, his successor, abolished the order in 1773. Through Pombal the Portuguese army received an entirely new organization and the fortifications on the frontiers were restored. He paid particular attention to the schools; he also rendered the censorship less strict. Joseph I died 24 Feb. 1777 and was succeeded by his daughter, Maria I, who immediately deposed Pombal and deprived him of all his offices. The state-prisoners whom he had incarcerated, 9,800 in number, were released, and all his regulations abolished. All those who had been attainted with treason under Pombal's charges were rehabilitated and he himself ordered to retire to his estate, where he died. His record is one of the bloodiest in Portuguese history, yet it is said to his credit that he favored the establishment of various manufactures; encouraged the art of printing and agriculture; furnished the University of Coimbra with a chemical laboratory, a botanic garden and an observatory; and introduced into Brazil the cultivation of coffee, sugar, rice, cocoa and indigo. Consult Moore, 'Life of Pombal' (1819); Opperman, 'Pombal und die Jesuiten' (1845); Weld, 'The Suppression of the Society of Jesus in the Portuguese Dominions' (1877); Feval, 'The Jesuits' (1878).

POMEGRANATE, a shrub or tree (*Punica granatum*), native of southern Asia, widely cultivated for its fruit. It is usually of bushy growth, with glossy entire leaves and red flowers. The fruit is globular, sometimes five inches in diameter, the interior filled with numerous seeds covered with a juicy red, pink or white pulp, usually of acid flavor. The cultivation of the pomegranate in the Old World is of great antiquity. The plant is supposed to have been introduced into southern Europe by the Carthaginians, whose Latin name of «Punici» was applied to it. The fruit is cultivated in the United States along the Gulf Coast and more extensively in tropical America.

POMEGRANATE MELON. See Melons.

POMELO, or **PUMELO.** See Shaddock.

POMERANIA, pŏm-ē-rā'ni-ạ (German, *Pommern*), Prussia, a northern province and duchy, bounded north by the Baltic, west by the duchy of Mecklenburg, south by the province of Brandenburg and east by West Prussia; area, 11,629 square miles. It consists of a long and comparatively narrow tract of country, stretching longitudinally east to west. The coast is generally low and sandy and is lined by a great number of lagoons, separated from the sea by narrow belts of land or low sandhills. Along the coast are a few islands, but none of them, except Rügen, Usedom and Wollin, are of great extent. The principal rivers are the Oder, Persante and Stolpe. The soil generally is sandy and indifferent; but there are many rich alluvial tracts, particularly along the banks of the rivers and lakes, producing a surplus of grain for export. Flax, hemp and tobacco also are cultivated. The domestic animals, of which sheep and swine are the most important, are numerous, and of tolerably good breeds. The forests are of large extent and well supplied with game. Fish also are abundant. The only minerals of any consequence are a little iron, salt and alum. Manufactures early made considerable progress, in consequence of the influx of French refugees on the revocation of the Edict of Nantes, who introduced the manufacture of woolens and other fabrics. Through the Oder the province carries on a considerable trade, both general and transit. The principal exports are corn, cattle, wood, wool, wax, amber and fish; the principal imports are wine, cotton goods, coffee, sugar and other articles of colonial produce. The centre of trade is Stettin, which ranks as one of the most important commercial cities of Prussia. Pomerania was originally inhabited by Goths, Vandals and Slavs. The first mention of it in history is in 1140. It long remained an independent duchy and was of much larger extent than at present. In 1637, on the extinction of the ducal family, the electoral house of Brandenburg claimed possession, but was obliged to give way to Sweden. On the death of Charles XII the electoral house again claimed possession and the whole was formally ceded to it except a part which received the name of Swedish Pomerania. This part having been ceded to Denmark, was by it given up in exchange for the duchy of Lauenburg, to Prussia, to which the whole of Pomerania now belongs. For administrative purposes it is divided into three governments (Regierungsbezirke), Stettin, Köslin and Stralsund. Pop. 1,716,921.

POMERENE, Atlee, American legislator: b. Berlin, Holmes County, Ohio, 6 Dec. 1863. In 1884 he was graduated at Princeton University and two years later at the Cincinnati Law School. In 1886 he was admitted to the bar and has since practised at Canton. In 1887–91 Mr. Pomerene was city solicitor; in 1897–1900 prosecuting attorney of Stark County and in 1906 was appointed member of the Tax Commission of Ohio. On 8 Nov. 1910 Pomerene was elected lieutenant-governor of Ohio and on 10 Jan. 1911 was elected United States senator for the term 1911–17 and was re-elected for the term 1917–23 in 1916.

POMEROY, pŏm' or pŭm'ĕ-roi, **John Norton,** American lawyer: b. Rochester, N. Y., 1828; d. 1885. In 1847 he was graduated at Hamilton College and became a practising lawyer in 1851. He practised in Rochester until 1864, when for four years he held the chair of law and political science at the University of New York. He returned to his law practice at Rochester in 1869 and from 1878 to 1885 held the chair of municipal law at the University of California. Pomeroy edited Sedgwick's 'Statutory and Constitutional Law' (1874) and Archbold's 'Criminal Law' (1876). He wrote 'Introduction to Municipal Law' (1865); 'Introduction to the Constitutional Law of the United States' (1868; 9th ed., 1886); 'Remedies and Remedial Rights According to the Reformed American Procedure' (1876); 'Treatise on Riparian Rights' (1884); 'Treatise on Equity Jurisprudence' (3d ed., 4 vols., 1905).

POMEROY, Marcus Mills («BRICK POMEROY»), American journalist and humorist: b. Elmira, N. Y., 25 Dec. 1833; d. Brooklyn, N. Y., 30 May 1896. He was apprenticed to the printer's trade when very young, established the Corning (N. Y.) *Journal* and the *Athens Gazette*, and in 1857 removed to Horicon, Wis., where he successfully conducted the *Argus*. Later he went to Milwaukee where he edited the *Daily News* and subsequently secured an interest in the La Crosse (Wis.) *Union and Democrat*. After the Civil War he removed to New York and founded the *Daily Democrat*, which in 1887 was merged in *Pomeroy's Advanced Thought*. In the latter part of his life he undertook to tunnel the Rocky Mountains, and had cut nearly a mile on each side when the failure of the national government to aid him caused the abandonment of the project. His chief publications are 'Gold Dust' (1872); 'Brick Dust' (1872); 'Perpetual Money' (1878).

POMEROY, Seth, American Revolutionary soldier: b. Northampton, Mass., 20 May 1706; d. Peekskill, N. Y., 19 Feb. 1777. He was by trade a gunsmith, and early spent much time in the colonial military service, attaining the rank of colonel. In 1774–75 he was delegate in the provincial congress, in October 1774 was made a general officer, and in February 1775 became brigadier-general of militia. After having participated as a private soldier in the battle of Bunker Hill, he was appointed 22 June 1775 senior brigadier-general of the Continental army. His appointment, however, was the occasion of some difficulty in the adjustment of matters of rank, and he resigned from the service, without having acted. When New Jersey was overrun by the enemy in 1776, he headed a volunteer force and marched for the Hudson, but died on the way.

POMEROY, Theodore Medad, American jurist and statesman: b. in Cayuga, N. Y., 31 Dec. 1824; d. Auburn, N. Y., 23 March 1905. He received his early education at Monroe Academy and graduated from Hamilton College, taking his degree in 1842. He was admitted to the bar in 1846, practising until 1870. In 1851 he was elected district attorney of Cayuga County, holding that position until 1856, when he was elected to the assembly. In 1861 he was elected to Congress, remaining there until 1869 and during the 40th Congress acting as speaker of the House of Representatives. In 1875 he was elected mayor of Auburn, serving one year, and was elected to the State senate in 1878–79. After abandoning the practice of law he engaged in banking and at the time of his death was first vice-president of the American Express Company.

POMEROY, Ohio, city, county-seat of Meigs County, on the Ohio River and on the Hocking Valley and the Kanawah and Michigan railroads, 125 miles southeast of Columbus. It was first settled in 1816 and incorporated as a city in 1846. It is built on a strip of land lying between the river on one side and hills on the other. It is in a region rich in bituminous coal and salt, and is the centre of an important mining industry. It also produces calcium and bromine, and has numerous manufacturing interests. Its industrial establishments include rolling mills, salt works, machine and engine works, furniture factories, planing and lumber mills and flour mills. There is a public library. The city is governed by a mayor, who holds office for two years, and a city council. Pop. 4,023.

POMFRET, a name given in Europe to a species of *Stromateus*, allied to our butterfish (*Rhombus triacanthus*), found in the Mediterranean and Indian Ocean; and in the Bermudas to a large fish (*Brama raii*) of the family *Bramidæ*. Both of these belong to the scomberoid series of percomorphous fishes. The latter is a fish of comparatively deep oceanic waters, and is quite cosmopolitan in its range. Occasionally it has been taken in our waters on both the Atlantic and Pacific sides. As a food fish it is of excellent quality, but is nowhere sufficiently plentiful to be of importance. The family *Bramidæ* is a small one, comprising only three genera and 10 or 12 species, which are remarkable for the changes which they undergo with growth. *Brama raii* reaches a length of four feet, and has a somewhat compressed form, with the dorsal and anal fins very long. The cycloid scales are peculiar in being provided with a deep perpendicular bony plate, one side of which is embedded in the skin.

POMMADE. See POMADE.

POMO, a linguistic stock of northwest California also known as Kulanapan. It includes several tribes, once very numerous, but now almost extinct. Consult Barrett, S. A., 'Pomo Indian Basketry' (Berkeley 1908); id., 'Ethnogeography of Pomo and Neighboring Indians' (ib. 1908); Mason, O. T., 'Aboriginal Indian Basketry' (Washington 1904).

POMOLOGY, the science of fruit-culture, especially apple-culture (Lat. *pomum*, apple). It is divided into four main divisions: viticulture, or grape-growing; orcharding (itself divided into the cultivation of pomaceous fruits; drupaceous or stone fruits; citrous fruits, as oranges and lemons; nut-fruits; and palmaceous fruits); small-fruit culture; and cranberry culture. (See Fruit-culture; Grape Industry; Horticulture; and special fruits, as apple, pear, orange, etc.). Consult Bailey, L. H., 'Cyclopedia of Horticulture' (4 vols., New York 1912).

POMONA, Cal., city in Los Angeles County, on the Atchison, Topeka and Santa Fé and the Southern Pacific railroads. It was first settled in 1875 and incorporated as a city 12 years later. It is the commercial centre and shipping point for an agricultural and fruit-growing region, particularly noted for its oranges; and also manufactures wine, and has a planing mill and a canning factory. It is a well-built, handsome city, with a fine park from which a wide view of the surrounding country may be obtained, and is a health resort. It has a high school and a public library, and Pomona College (q.v.) is located within a few miles at Claremont. The city is governed by a board of trustees; the city officials are mostly elected directly by the people. Pop. 13,150.

POMONA. See Orkney Islands.

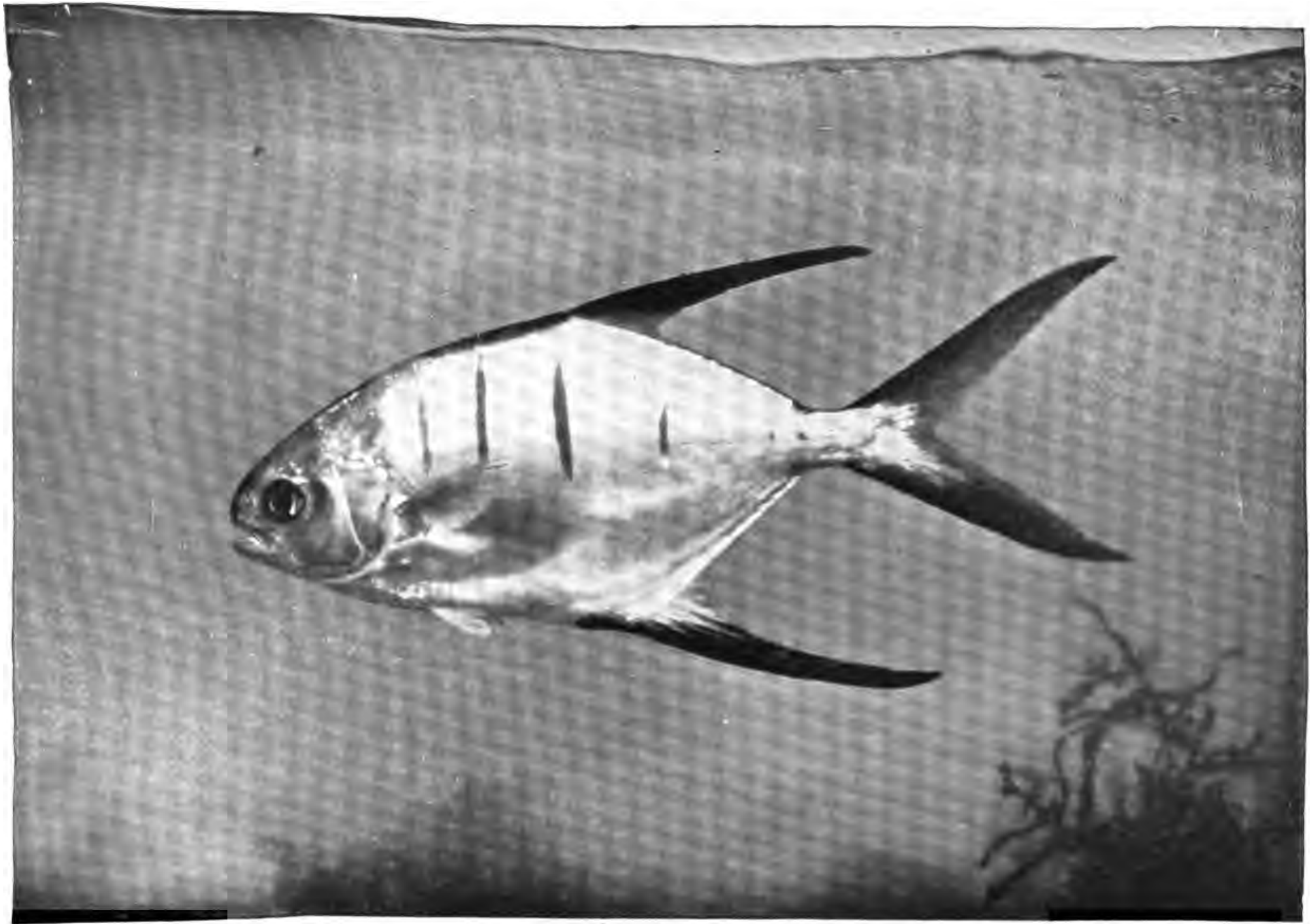
POMONA, the Latin goddess of fruit, orchards and gardens. Various legends are associated with her cult. The longest story as also the most famous concerning her is told by Ovid in his 'Metamorphoses' (XIV, 623 et seq.). Consult Wissowa, Georg, 'Religion und Kultus der Römer' (2d ed., Munich 1912).

POMONA COLLEGE, located at Claremont, Cal. It was established by the Congregationalists, and was first opened to students in 1888, but it is now non-sectarian in control. Women are admitted to all courses. The college offers three general courses, classical, scientific and literary, for the completion of which the degrees of A.B., B.S. and B.L. are conferred. There is also provision for graduate work, a normal course and a preparatory department. In 1917 the grounds and buildings were valued at $530,880; the amount of productive funds was $1,105,358, and the annual income $204,957. The library (1917) contained 35,510 volumes; the students number 542, and the faculty 46.

POMORYANS, a Russian sect founded in 1695 by Danilo Wiculin. Their teachings are called Danilowtchina, and inculcate the doctrine that since the deposing of the prelate Nikon (1667), Antichrist has reigned in the Orthodox Greek Church, and thus the true priesthood has been destroyed. As there are no longer true priests nor true sacraments, there is no authority to sanction marriage, and, therefore, all should live in celibacy; and those married in the Greek Church should separate. Persons desiring to join the sect are required to be rebaptized by those already members. The sect has monasteries and nunneries, and has amassed much wealth which they have expended in gathering a large and very valuable library treating principally on the fine arts — music, painting, poetry, etc.

POMPADOUR, Jeanne Antoinette Poisson, zhän äṅ-twän-ĕt pwä-sôṅ pôṅ-pä-door, Marquise de, mistress of Louis XV: b. 29 Dec. 1721; d. Versailles, 15 April 1764. She was the daughter of François Poisson, equerry to the Duke of Orleans, and not butcher to the Invalides as frequently stated. The paternity of the future favorite was, however, claimed by Lenormand de Tournehem, a rich fermier-général, who spared no pains to give her a brilliant education, and at his death left her the half of his immense fortune. In 1741 she was married to her cousin Lenormand d'Etiolles. She succeeded in attracting the attention of the king, was formally presented to him and soon entirely engrossed his favor, appearing at court under the title of Marquise de Pompadour. Here she enjoyed the highest consideration, but did not at first interfere in political affairs, satisfied with appearing as the patroness of learning and the arts. She collected books, pictures and curiosities, and encouraged the institution of the military school of which Paris du Verney was the founder. But when she could only maintain her influence with the king by furnishing him other objects for favor, she turned her attention to state affairs. She filled the most important offices with her favorites, and contributed to produce those evils which afterward pressed so heavily on France. It is said to have been principally owing to her that France became involved in the war against Frederick II. The Empress Maria Theresa had propitiated her favor by writing to her with her own hand a letter in which she called her "dear cousin." The burdens and sufferings which this war brought upon France must be laid at her door, since she removed Berms, who was in favor of peace, and supplied his place by Choiseul, effected the recall of Marshal d'Estrées at the moment of triumph, and promoted incapable generals to the command. She died little regretted by the king (see Louis XV), and hated and reviled by the nation. To her credit, however, is awarded praise for her patronage of literary men and artists. Consult Beauporist, 'Secret Memoirs of La Marquise de Pompadour' (1885); Goncourt, 'Madame de Pompadour' (1887); Pavlovski, 'La Marquise de Pompadour' (1888); Fleury, 'Louis XV intime' (1899); De Caraman, 'La Famille de la Marquise de Pompadour' (1900).

POMPANO, an important food fish (*Trachinotus carolinus*) belonging to the teleostomous family *Carangidæ*, and found chiefly in the southern United States, especially in Florida. These fishes are related to the mackerels, but lack the median finlets which are so general in the latter. The pompano reaches a length of about 18 inches and has a somewhat elevated and compressed body with a covering of very small scales and a strongly convex steep forehead. The anal and soft



From "American Food and Game Fishes"

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OLD WIFE

This is [illegible] of the [illegible]. Photographed from life at Key West, Florida

dorsal fins are both long and of nearly equal length and similar form, being very high in front and low behind. There is a spinous dorsal fin from which the membrane disappears with age, and a deeply forked caudal without keels or bony plates on its peduncle. The jaws are at first provided with numerous small teeth which fall out with age, changes in other parts also taking place. The color is a beautiful polished silvery blue with golden reflections in parts and touches of orange on the paired fins. On the Atlantic Coast the pompano ranges from Brazil to Cape Cod; but it is only in the warm waters of the south Atlantic and eastern Gulf coasts that it is plentiful. Although occurring on the Pacific side of the continent it is there nowhere common. Except at the extreme southern end of Florida the pompano is a migratory fish, coming in from the sea and entering the shallow bays in the spring, the migratory wave gradually moving up the coast and reaching the waters of New Jersey and Massachusetts only when the summer is well advanced. In the fall they leave at a correspondingly early date. They approach the shores in large schools, swimming swiftly at the surface, but some time after entering the shallow bays break up into small parties to spawn and search for the shellfish which are their chief food. The largest runs come in April and May, and, as the dense schools approach very close to the shelving shores, seines may be operated with great effect, and large quantities are thus taken in Florida and South Carolina. Farther north, in Chesapeake Bay and on the coasts of New Jersey and Massachusetts, they are taken in pound nets. The pompano is the favorite fish of the wealthy and commands a high price in Northern markets. The name pompano is also applied to other species of the same and related genera, but the Irish pompano (*Gerres*) and California pompano (*Rhombus*) are not closely allied. Consult Goode, ‘American Fishes’ (New York 1888); Jordan and Everman, ‘American Food and Game Fishes’ (New York 1902).

POMPEII, pŏm-pā'yē (Lat. pŏm-pē'yi), ancient city of Italy, near the Gulf of Naples, and 12 miles southeast of Naples, lying at the southeast base of Vesuvius, and important as being preserved almost intact to our own time by a shower of ashes and pumice from Vesuvius 24 Aug. 79 A.D., which also covered Herculaneum. The city, according to Strabo, was founded by the Oscans; it must have come under Hellenic influence by the 6th century for a temple unearthed in the city is of the Doric of that century. Held by the Samnites from 420 B.C. to the end of the Samnite War in 290, Pompeii then became dependent on Rome; and two centuries later at the close of the Social War the city which had sided with the Italian allied forces was captured by Sulla, and was forced to cede a third of its territory for a Roman military colony. In the years that immediately followed Pompeii became a favorite resort of rich and fashionable Rome, being near the sea and having the glamor of Greek elegance. An earthquake in 63 A.D. nearly destroyed the city, and when it was rebuilt and resettled, Roman architecture somewhat took the place of Greek and the work of building seems to have been shabby and far from thorough in many instances. But the city had regained much of its old popularity when it was destroyed by the eruption of Vesuvius in the year 79. Few of the inhabitants escaped, but the better class of buildings was scarcely injured by the alternating falls of ashes and *rapilli*, or pumice. These with the additional covering of earth now amount to about 20 feet. The eruption is described by Pliny the Younger in letters written to Tacitus telling of the death of the elder Pliny, who perished in the city. The site, for a time occupied by a little village, was deserted after the eruption of Vesuvius in 472, and no attention was paid to this great storehouse of antique life until the middle of the 18th century. Indeed the precise position of the buried city was problematic, for the volcano had changed the coast line so that it is now some distance from Pompeii. In 1748 valuable finds were made by a peasant digging a well. In 1755, Charles III having become interested in the work, the amphitheatre and other public buildings were discovered. But during the next 50 years nothing systematic was done: there was still search for rare objects, but when these were found houses and streets were left to decay or were covered up again. No one realized that the prime value of the city archæologically is that it is the genuine setting of Roman life, a very different thing from remnants, no matter how curious, in a museum. Under Murat (1808–15) houses and streets were again excavated; and since the establishment of the united Italian kingdom work has been carried on systematically by the government, notably under the management of Fiorelli, who devised a method of making casts of the human remains by pouring plaster into the hollows occupied by the bones of the victims. The streets are now nearly half exposed; the completion of the work may take 50 years more. The fear has occasionally been expressed that an eruption of Vesuvius might undo all this work, and, if lava were poured down on the city, all the ancient monuments be destroyed.

The importance of the city, as has been remarked above, is that the very pose and setting of 1st century Italy is here preserved in a wonderful degree, even loaves of bread keeping their shape though turned to charcoal. It is, however, important to notice that the city is neither typical of Rome because of its being subjected to Greek influence, nor of Greece, because hastily rebuilt after the earthquake of 63 A.D. Hence generalizations as to Roman manners and customs founded merely on Pompeian remains are liable to error. The city was an irregular oval, the length being east and west, surrounded by a wall with a circuit of a little more than a mile and five-eighths (2,925 yards), which is pierced by eight gates. At each there were sentry boxes in which the Roman legionaries were found, still «on duty» when the excavations began. The most important gate is that opening toward Herculaneum, on the west end of the ovoid. From this gate leads a road paved with tombs, the Pompeian *Via Appia*. Parts of this region, the Pagus Augustus Felix, were among the earliest excavated; in 1771–74 the diggers discovered the villa of Diomedes, which got its name from the tomb of Marcus Arrius Diomedes across the street. It seems to antedate the empire. Thirty-four bodies were found in this one house, 20 of them in the wine cellar. Within the walls the streets are straight but narrow (14 to 24 feet wide), paved with lava blocks, and with high stepping stones at crossings. The streets are deeply worn with ruts. On the walls there are scribbled inscriptions, the famous graffiti, which are full of the gossip, scandal and politics of the city. The forum, a little southwest of the geographical centre of the town, was an open market place surrounded by buildings, the temple of Apollo lying to the west, the temple of Jupiter to the north and that of Mercury to the east. The last temple was flanked by the curia on the left and the house of Eumachia on the right; south of this house, across a street leading to the Sarno gate, was a school. At the intersection of this street with that connecting the Vesuvian and Stabian gates were situated the public baths; and near the latter gate were a second forum, called the "triangular," a temple of Isis north of it, a large and a small theatre to the east, the extensive gladiators' barracks to the southeast, noted for the fine arms, shields, helmets, etc., discovered here, and to the south a temple of Heracles. The gladiators' quarters include a large rectangular enclosure, which measures 183 feet long by 148 feet wide. It is surrounded on all four sides by a colonnade whose columns are painted red at the lower part, and alternately red and yellow at the upper. The wall back of the columns is covered with stucco. Other baths are on the street crossing the city from the Nolan gate. The unfinished temple of Venus Pompeiana in the southern corner of the city, near the old Sea gate and the modern hotel, seems to have been the repository of many valuables, probably left by the inhabitants who escaped from the city at the first alarm. Valuable finds of the same sort are to be looked for in villas outside the city; in 1895 in a well at Boscoreale a set of silver utensils, lamps, mirrors and candelabra was discovered. The type of art in these pieces of silver and in the mural paintings is apparently Alexandrian, with a profusion of Cupids. Among the better known private dwellings, apart from the "Villa of Diomedes" already named, are the house of Pansa, one of the largest residences of the city, a pattern of the Roman house which has often been reproduced, notably at Saratoga; the house of the Tragic Poet, so called because of the incorrect interpretation of one of its mural paintings, a small but tasteful house with remarkable scenes from the Homeric poems; the unusually elegant house of Sallustius; the double house known as Castor and Pollux; and the house of the Vettii, excavated in 1894, the home of a rich fuller, with brilliant, fresh frescoes, and the interior equipment of the house in such good condition that it has been left there instead of being carried to the Museum in Naples.

The discoveries produced by the excavation of the ruins of buried Pompeii and Herculaneum were of vast interest from the viewpoint of archæology; but a far greater effect produced was from a popular standpoint, namely, the revolution in the modern world of art, and the decorative arts especially. The early excavations created a classic influence in the architecture and decoration in France during the reign of Louis XV, which, with the more advanced disclosures, entirely dominated the style Louis XV, to become excuse for the debased copies of these antiquities in the empire style. In England the disinterment of these Greco-Roman ruins and relics brought into being the Adam Period of architecture and decorative art (1760–94).

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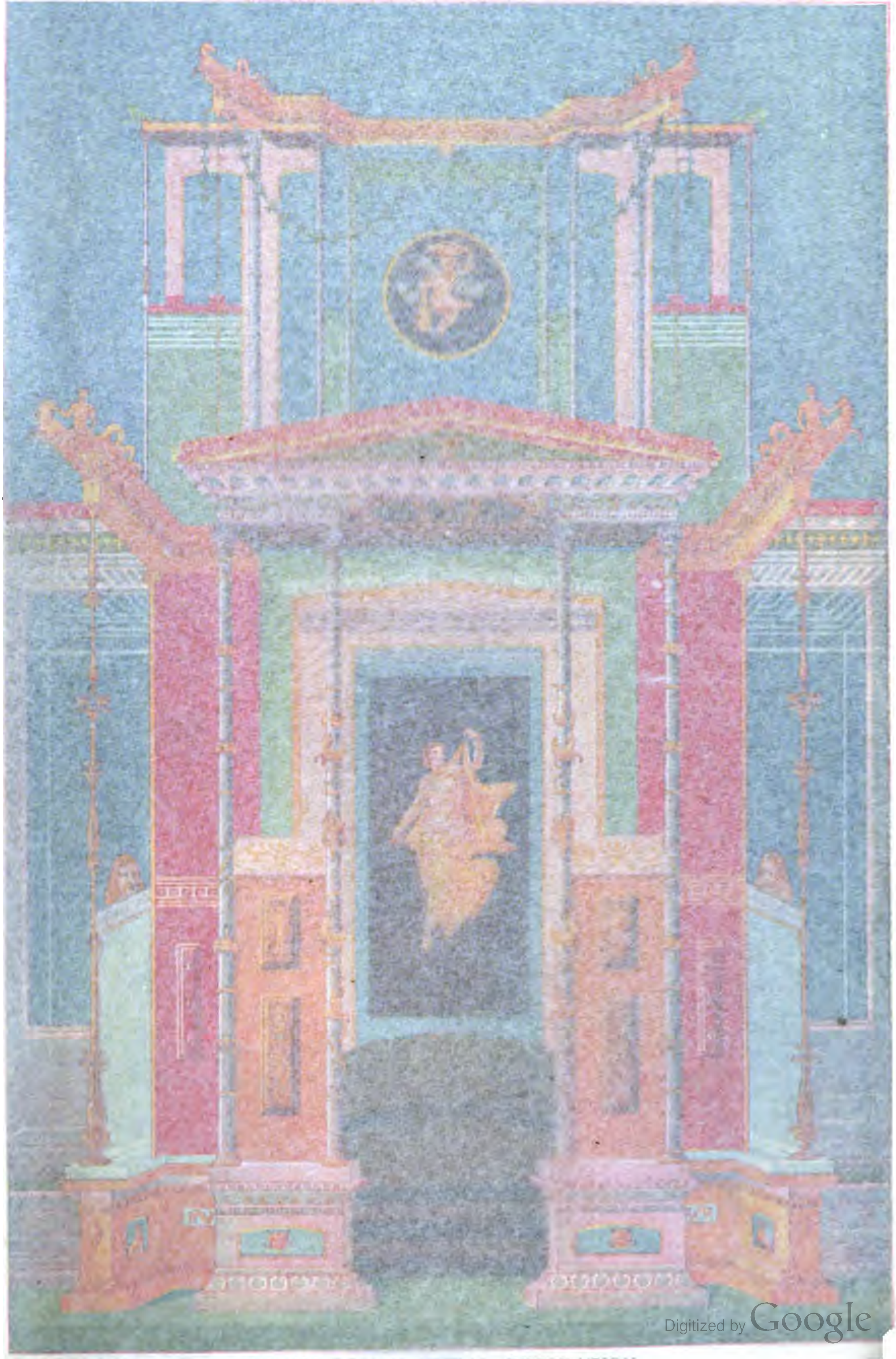
POMPEY, pŏm'pĭ (CNEIUS POMPEIUS), surnamed the Great (Magnus): b. 30 Sept. 106 B.C.; d. 28 Sept. 48 B. C. In 98–87 B.C. he served in the Social War with great distinction. For some years subsequently the party of Marius was in the ascendant in Italy, and Pompey, who belonged to the aristocratic party, kept in the background. Learning, however, that Sulla was about to return from Greece to Italy, he hastened into Picenum, and raised an army of three legions, with which he successively defeated three generals of the opposite party, who attempted to prevent his junction with Sulla. That junction was accomplished in 83, and Sulla received the young soldier with the greatest marks of esteem. When the war in Italy ended, Pompey was sent to Sicily against the Marian general. He won a complete and speedy victory, and on his return was received by the people with great enthusiasm, and greeted with the surname of Magnus. He was also granted a triumph, a noteworthy distinction for one who had as yet held no public office. Subsequently he induced the Senate to send him to the aid of Metellus Pius, hard pressed by Sertorius in Spain. Pompey remained in Spain (76–71), but neither he nor Metellus could gain any advantage over Sertorius. But when the latter was treacherously murdered by Perperna, his own officer, the war was speedily brought to a close. On his return he defeated the fragments of the army of Spartacus, and claimed the glory of having finished the Servile War. He now became a candidate for the consulship, and although he was not of the legal age, and had not held any of the lower offices of the state, he was elected consul with Crassus at the end of 71. The aristocracy began to look upon Pompey with jealousy, and ceased to regard him as belonging to their



GRÆCO-ROMAN MURAL DECORATION

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Bibliography.— Adams, S., 'Relics of An[illegible] [illegible] in the Ruins of Pompeii and [illegible]' (New York 18[illegible]); Barré, L., [illegible] 'Herculanum et Pompéi' [illegible] F., [illegible] (Naples 1860); [illegible] G., '[illegible] Rediscovery' [illegible] 'Pompeii, its [illegible]' [illegible] d'Herculanum [illegible] Musée [illegible] de [illegible] (Naples 1870); [illegible] in seinen Gebäuden [illegible] Kunstwerken (Leipzig [illegible]); [illegible] Antiquities of Herculaneum and Pompeii' (Naples 1862); Winckelmann, J. J., 'Recueil de Lettres sur les Découvertes faites à Herculanum, à Pompéi, à Stabia, etc.' (Paris 1[illegible]). See also HERCULANEUM.

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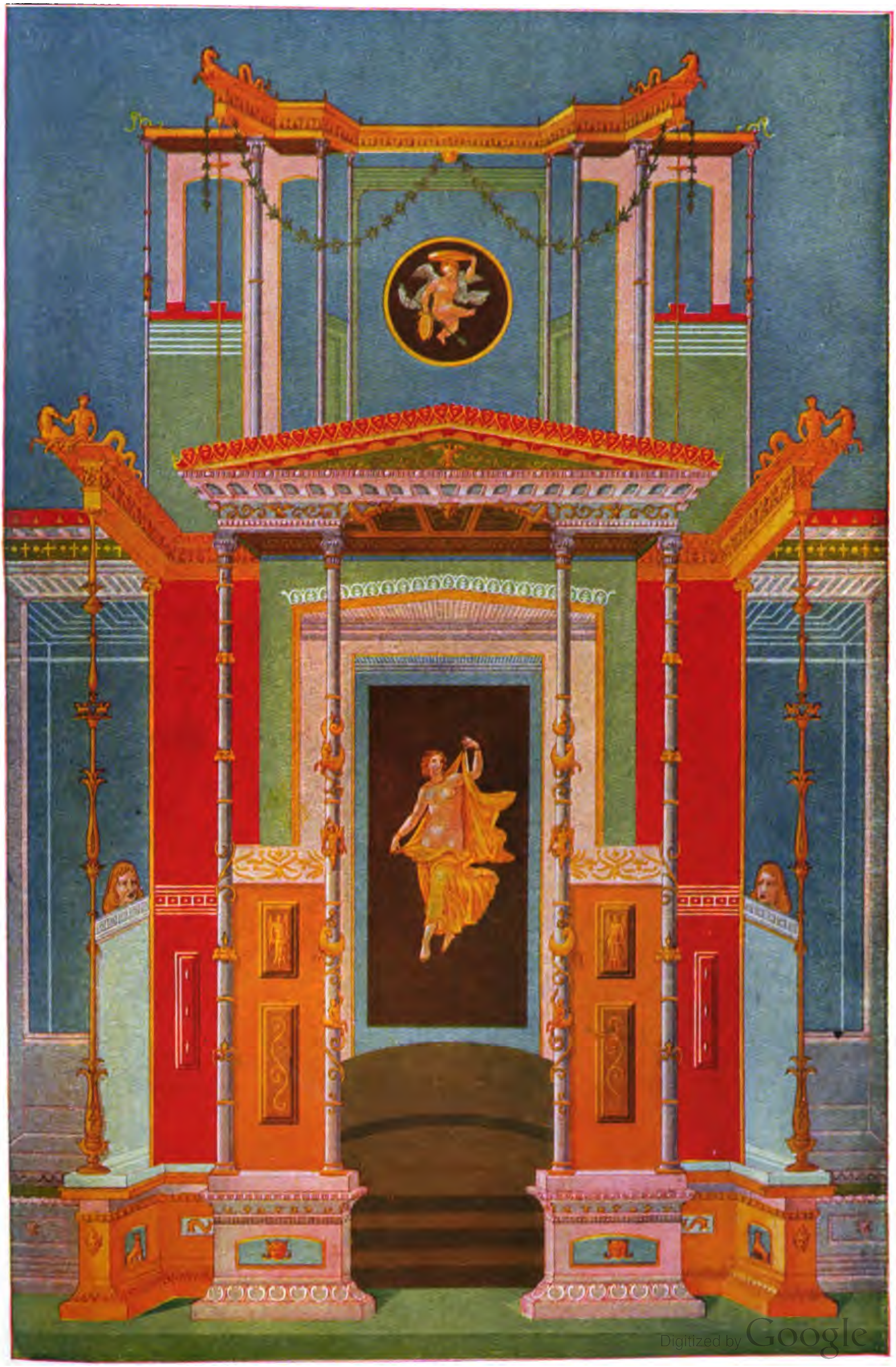
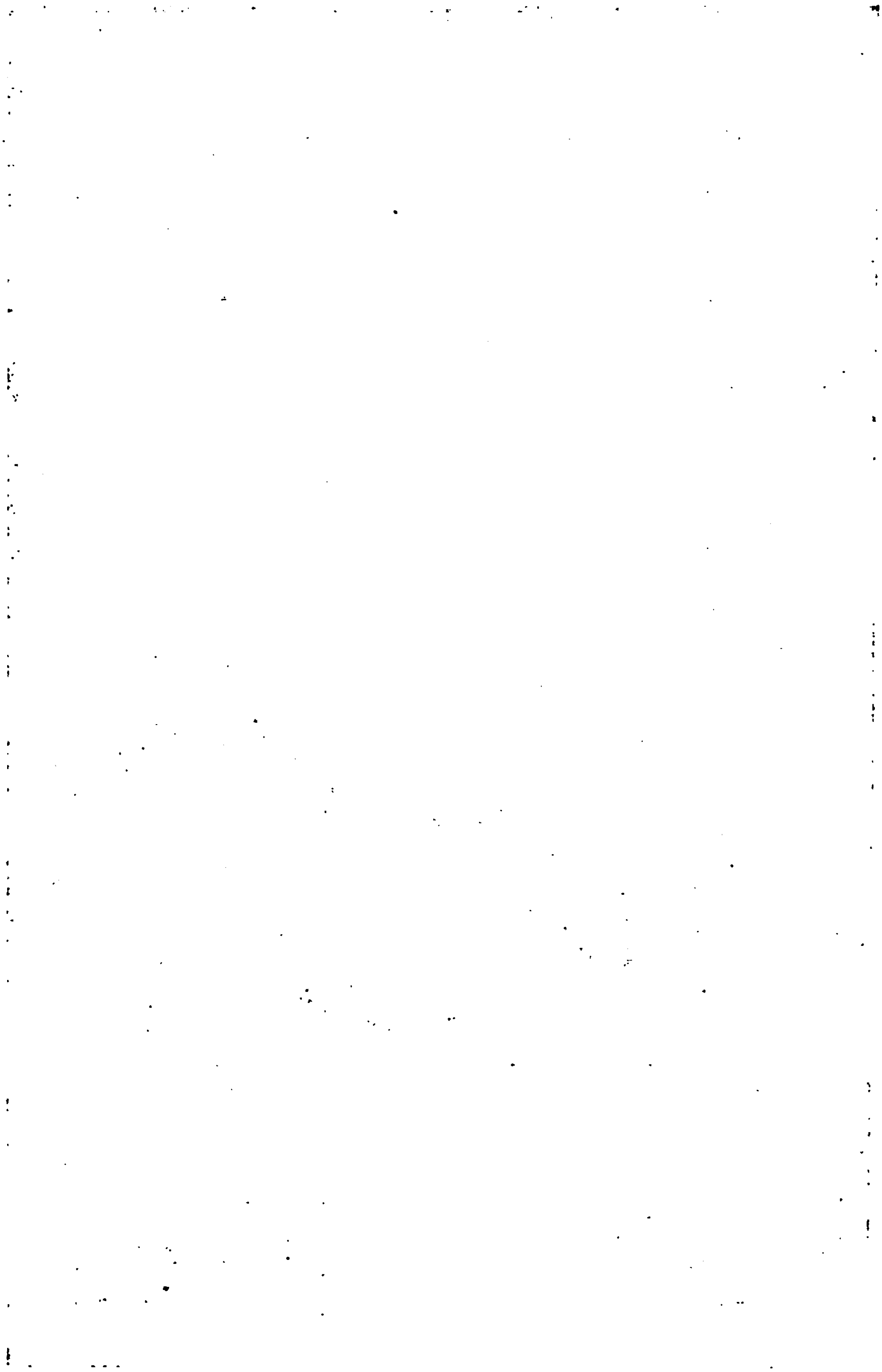
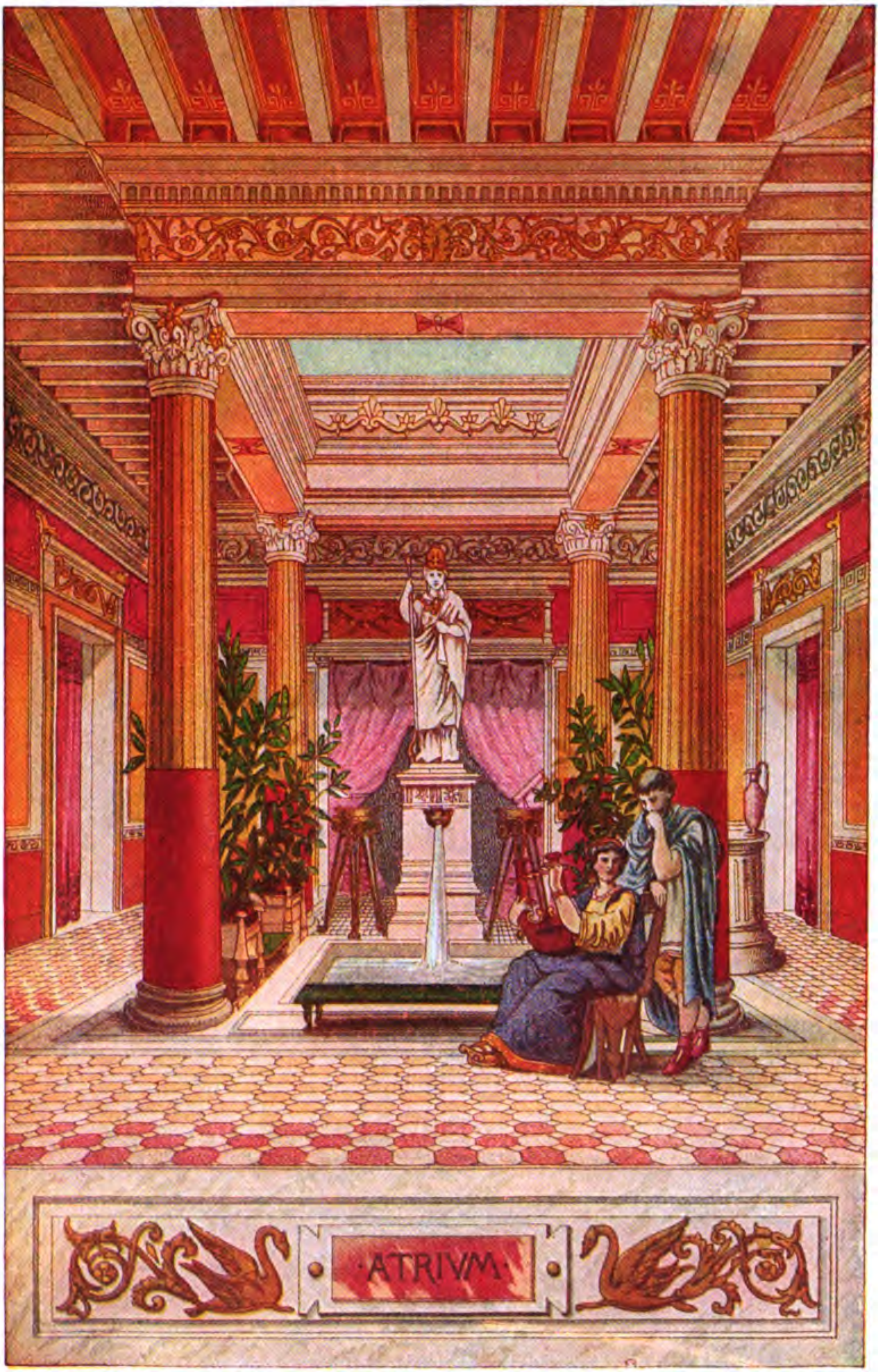


GRÆCO-ROMAN MURAL DECORATION



ATRIUM [illegible] IN POMPEII



ATRIUM, OR COURT OF A HOUSE, IN POMPEII

party, as he and his colleague openly courted the people — Crassus, by profuse largesses, and Pompey by the restoration of the tribuneship and other popular institutions. In 67 he was invested with extraordinary powers by sea and land for three years, for the purpose of putting an end to the outrages of the pirates in the Mediterranean, in which he was successful. Meanwhile the war against Mithridates had been carried on with varying fortune, and the Romans were discontented with the slow progress of Lucullus. The tribune, Caius Manilus, proposed that Pompey should have absolute power over the army and fleet in the East, and proconsular authority over all Asia as far as Armenia, a proposal supported by Cicero in the famous oration 'Pro Lege Manilia.' It was opposed by the whole influence of the aristocracy, but carried triumphantly. In 65–62 he conquered Mithridates; Tigranes, king of Armenia; and Antiochus, king of Syria. At the same time he subdued the Jewish nation, taking Jerusalem by storm after a three months' siege. He returned to Italy in 62, and disbanded his army, but did not enter Rome till the following year, when he had the honor of a third triumph. From this date, when he was 45, his star began to wane. The aristocracy still distrusted him, yet he was unwilling to throw in his lot entirely with the popular party, which had been steadily rising in power during his absence, and over which Cæsar now possessed unlimited control. The Senate refused to sanction his measures in Asia, and to make an assignment of lands which he had promised to his veterans. Pompey, therefore, resolved to ally himself closely with Cæsar, who promised to obtain the ratification of his acts provided Pompey would assist him in the attainment of his ends. Through the mediation of Cæsar Pompey became reconciled to Crassus, who, in consequence of his enormous wealth, had a wide influence in Rome. Thus was brought about the coalition of these three powerful men, which is known in Roman history as the first triumvirate. In order to tighten the bonds of alliance Cæsar bestowed upon Pompey his daughter Julia in marriage. It was soon apparent that this alliance would not last long, as Pompey could brook no rival. The death of Julia in 54 severed one of the ties which bound the two men, soon to become open rivals. In consequence of the serious tumults which broke out in Rome on the death of Clodius in the beginning of 52, the Senate called in the assistance of Pompey, who was appointed sole consul for that year, and who succeeded in restoring order in the city. The most important state offices were now filled with Cæsar's enemies, and Pompey persuaded the Senate to pass a decree by which Cæsar was to give up the provinces of which he was governor, and the command of his army. This he refused to do unless Pompey would throw up his offices, which was a step the latter would not take. Cæsar was proclaimed an enemy to the state, and his rival was appointed general of the army of the republic. Cæsar crossed the Rubicon in 49, and in 60 days was master of Italy without striking a blow. Pompey fled to Greece, where he collected a numerous army, and was followed by Cæsar in January 48. At first the campaign was in Pompey's favor; Cæsar was repulsed before Dyrrhachium with considerable loss, and was compelled to retreat toward Thessaly. In this country, on the plains of Pharsalia, occurred the decisive battle which made Cæsar master of the Roman world. His rival fled to Egypt, where he was murdered in the presence of the king and his army by the tribune Septimius, at the instigation of Achillas and Herodotus, who feared the anger of Cæsar. His head was struck off, and was shown to Cæsar, who, however, ordered the murderer to be put to death. Consult his life in Druman's 'Geschichte Roms,' iv, 324–556; Merivale, 'The Roman Triumvirates' (1887).

POMPEY THE YOUNGER (SEXTUS POMPEIUS), Roman warrior, 2d son of Pompey the Great: b. 75 B.C.; d. 35 B.C. He accompanied his father in his flight into Egypt and after his death went to Spain, where he organized a force of fugitives and malcontents and demanded from the Roman Senate restitution of his father's property. The Senate granted him a large sum of money and made him commander of the seas. He marched to Bætica, where he crushed all opposition and assumed the powers of a sovereign. Upon the formation of a second triumvirate in 43 B.C. he was proscribed and thereupon turned pirate, waging continued war upon Rome by cutting off her supplies. He made Corsica, Sardinia and Sicily, which islands he had captured, the seat of his power, and from them sent forth his marauders. When Rome reached the point of starvation the populace compelled Antonius and Octavianus to sue for peace and a treaty most advantageous to Sextus was signed, in which he was confirmed in his occupation of Sicily, Corsica, Sardinia and Achaia, and promised the consulship. The war was, however, speedily resumed, and Sextus twice defeated the fleets of Octavianus, but his indecision permitted the Romans to rebuild their fleets and in 36 B.C. he was signally defeated. He fled to Armenia, but being overtaken by his enemies and deserted by his troops, he surrendered, and was put to death at Miletus by the Roman legate, M. Titius, who wished to remove a man who might easily be the cause of a rupture between the triumvirs. He had assumed the name of Pius, because he endeavored to avenge the death of his father and his brother, and this surname appears on many of his coins.

POMPEY'S PILLAR, the name of a celebrated column, standing on an eminence about 1,800 feet to the south of the walls of Alexandria in Egypt. It consists of a capital, shaft, base and pedestal, which last rests on substructions of smaller blocks once belonging to older monuments. One of these blocks bears the name of a monarch of the 13th Egyptian dynasty, and another that of Psammetichus I. The total height of the column is 98 feet 9 inches; the shaft, a monolith of red granite, is 73 feet long, and 29 feet 8 inches in circumference. The name it is popularly known by was applied to it by ancient travelers for no assignable reason. An inscription on the base shows that it was erected by Publius, the prefect of Egypt, in honor of Diocletian, probably to commemorate his capture of Alexandria, and the suppression of the rebellion of Achilleus. On the summit there is a circular depression of considerable size, intended to admit the base of a statue.

POMPEY'S THEATRE, a theatre of ancient Rome, erected by the great Pompey and completed in 52 B.C. It was the first stone theatre of ancient Rome; had a marble interior and is variously stated to have seated 10,000, 17,000 or 40,000 people. After surviving many conflagrations it finally collapsed in the 6th century. Some of the ruins are still discernible about the Palazzo Pio. Consult Platner, S. B., ‘The Topography and Monuments of Ancient Rome’ (2d ed., 1911).

POMPONATIUS, Petrus, pŏm-pō-nā'shĭ-ŭs pē-trŭs (Latinized name of Pietro Pomponazzi), Italian philosopher: b. Mantua, 1462; d. Bologna, 1525. He was one of the leading Greek revivalists of the Renaissance and taught peripatetic philosophy in Padua and Bologna, endeavoring to purify the current Aristotelianism from the ecclesiastical admixture of scholasticism. In his essay ‘De Immortalitate Animæ’ he taught that the application of Aristotle's method would necessarily result in a proof of the soul's mortality and confirmed the Greek criterion of «virtue for its own sake» as an ethical standard, in «Præmium essentiale virtutis est ipsamet virtus quæ hominem felicem facit.» His treatise ‘De Incantationibus’ was directed against the superstitions of his time. His works were published in Venice (1525) and in Basel (1567).

POMPONIUS, Lucius, Latin writer who flourished about 90 B.C. He was a native of Bonia. He was the first author to give form and finish to the Atellanæ Fabulæ, the popular plays which before his time were largely improvisations. He introduced a written text in the technical form of the Greek playwrights. The parts of his work which have come down to us show a skilful use of the rustic dialects and not a little obscenity. The fragments are contained in O. Ribbeck's ‘Scenicæ romanorum poesis fragmenta’ (Leipzig 1897–98). Consult Duff, J. W., ‘A Literary History of Rome’ (London 1909).

POMROY, Rebecca Rosignol, American nurse: b. Boston, Mass., 1817; d. 1884. She was the daughter of Samuel Holliday and in 1836 married Daniel F. Pomroy. Her experience as nurse was gained within her own family circle, and at the beginning of the Civil War she offered her services to the government. During the war she was stationed successively at Georgetown Hospital, West Hospital, Baltimore and Columbian University Hospital, Washington, D. C. On two occasions Mrs. Pomroy attended the family of Abraham Lincoln. About the end of the war she had an attack of typhoid fever which left her an invalid for many years. Upon regaining her strength she was engaged as matron in a girls’ reform home at Newton Centre, Mass., and subsequently in the Newton Orphan Home, since named the Rebecca Pomroy Home.

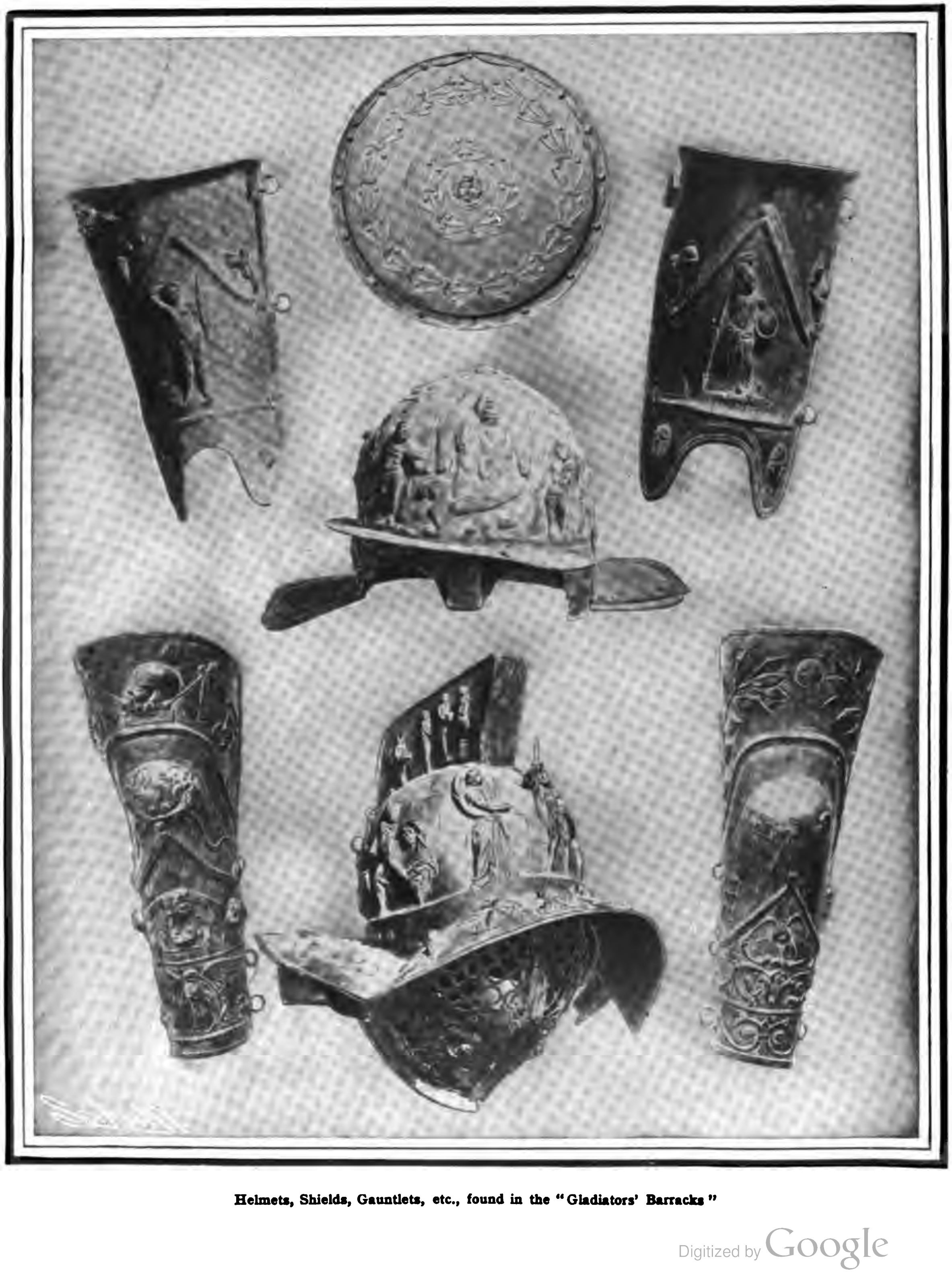
PONAPÉ, pō'nā-pā, one of the Caroline Islands (q.v.) in Micronesia, in form nearly circular, with a diameter of 16 miles and an area of 140 square miles and ringed by a coral reef three miles distant. The interior is mountainous, the coast fertile. Mangroves flourish and durian and vegetable-ivory nut are exported. Remarkable ruins consisting of great blocks of basalt have been found. The island belongs to the group of Eastern Carolines, of which the town of Ponapé is the seat of government. Pop. (est.) 2,000. Consult Pereira, ‘La isla de Ponapé’ (1896).

PONCA (pŏn'ką) **CITY**, Okla., city in Kay County, on the Arkansas River, the Atchison, Topeka and Santa Fé and the Hutchinson and Southern railroads, 63 miles north of Guthrie. It contains flour mills, oil refineries, grain elevators, glass works and a tent-making factory and has extensive wheat-growing interests. There is a public library and a considerable trade is carried on with the Indians. Pop. 2,521.

PONCA INDIANS, one of the five tribes of the so-called Dhegilia group of the Siouan family, forming with the Omaha, Osage and Kiansa, the upper Dhegilia or Omaha division. The Ponca and Omaha Indians have the same language, differing only in some dialectic forms and approximating the Quapaw rather than the Kansa and Osage languages. They are a partly civilized and peaceable race. They became separated into two bands; one, numbering about 600, remained in the former Indian Territory, while the other, numbering about 225, retained their reservation in Nebraska. In 1906 the bands numbered respectively 570 and 263, total 833.

PONCE, pōn'sā, Porto Rico, city, capital of the department of Ponce, three miles from the coast. It is the second largest city of Porto Rico and the first in commercial importance. Coffee is the most important export. Other exports are sugar, rum, molasses and tobacco. The main part of the town is connected with the port, Playa, by a good road and electric railway. The harbor is large and accommodates vessels drawing 25 feet; the custom-house is located at Playa. Ponce is connected with Yanco, 20 miles distant, by railroad and with San Juan and Arecibo by highways. The greater part of the inhabitants are engaged in commercial and mercantile pursuits; but there are a few mechanical industries, shoemaking, etc., and the mechanics of Ponce excel in the quality of their workmanship. The city is considered the most progressive on the island; it is well built and modern in appearance, with wide streets, several plazas or open squares, the largest of which is the Plaza Principal and a number of handsome residences. It has also the best market-house and best market on the island. The water supply is excellent; there are electric lights and electric railways; the chief buildings include the church of Our Lady of Guadalupe (Roman Catholic), a Protestant church, the municipal hall and two theatres. There are also several asylums and hospitals. The city has a public library and a good public school system has been established since the American occupation. In 1918 the city had two earthquake visitations; in the second (15 October) Red Cross workers estimated that 600 families were rendered homeless.

PONCE DE LEÓN, pōn'thā dā lā-ōn', **Fray Luis de**, Spanish theologian and poet: b. Belmonte, La Mancha, 1527; d. Madrigal, Spain, 23 Aug. 1591. He entered the Augustian order at 16, was educated at the University of Salamanca, where he later became professor of theology and of Thomistic philosophy. As a linguist and a theologian he became famous,



Helmets, Shields, Gauntlets, etc., found in the "Gladiators' Barracks"

but in 1572 was brought before the Inquisition on a charge of Lutheranism and of having translated into Spanish without authorization the ‹Song of Solomon.› He was held in prison until 1576, when he was reinstated in his offices in the university and subsequently became vicar-general and finally provincial of his order. His lyrical poetry is chiefly of a religious character and though small in quantity is of great merit. He translated the ‹Eclogues› and two of the ‹Georgics› of Virgil, about 30 odes of Horace, 40 of the Psalms, besides selections from modern Greek and Italian poets. His most popular prose work was ‹Perfecta casada› (‹The Perfect Wife,› (1583), a treatise in the form of a commentary on portions of the book of Proverbs, a treatise on wifely duties. Another notable prose work was a treatise on the ‹Names of Christ› 1583). The best edition of his works is that of Merino (6 vols., 1804–16). Consult J. Gonzales de Tejada, ‹Vida de Fray Luis de León› (1863); Ford, J. D. M., ‹Luis de León, the Spanish Poet, Humanist and Mystic› (in the ‹Publications of the modern Language Association of America,› Vol. XIV, No. 2).

PONCE DE LEÓN, Juan, Spanish discoverer: b. Leon, about 1460; d. Cuba, 1521. He fought in the conquest of Granada and in 1493 shipped with Columbus on the admiral's second voyage. Subsequently he held under Ovando the post of governor of the eastern portion of Española, in 1508 undertook the conquest of Porto Rico and in 1510 was made governor of the island. He had already played a brave part in the struggles attending Spanish colonization in the New World, when in 1512 he obtained from King Ferdinand permission to conquer Bimini. The Indians seem to have spoken of a land called Bimini, north of Española and in the 1511 edition of the ‹Decades› of Peter Martyr is a map on which appears a large island named Beimeni. To this Bimini Ponce de León was going for the «Fons Juventatis,» or fountain of youth, the belief in such a fountain being a part of the folklore of his day. A spurious letter purporting to be from John Prester (q.v.), circulated through Europe in the 12th century, tells of such a fountain. Sir John Mandeville calmy appropriated the story, described the fount as at a place called Polombe and said that he «drank thereof thrice,» and «feel me the better and the haler.» Stories of an island northward of Española, where a fountain of youth was, must have been afloat in Spain; for the same 1511 edition of the ‹Decades› refers to them. In the patent granted in 1512 to De León, condition was made that the island had not been already discovered. In March 1513 the veteran set sail with three caravels from San German in Porto Rico. On the 27th he came in sight of the mainland on which he landed, 2 April, taking possession in the name of the king and calling the region Florida, since 27 March had been Easter Sunday, styled by the Spaniards Pascua Florida («flowery Easter»). The spot at which he landed was a little northward of the present site of Saint Augustine. He then coasted about the peninsula to the west side, reaching lat. 27° 30′. The bay at which he arrived was long known as Juan Ponce. He reached Porto Rico on the return voyage 21 September. He had to subdue the Caribs, a long undertaking; and not until 1521 did he attempt a new expedition. Then with a new patent for conquest and settlement, he set out with equipment for starting a colony. The hostility of the Indians, however, rendered the success of the enterprise doubtful. Ponce De León was severely wounded by an arrow and returned with the whole expedition to Cuba, where he died of his wound. He had not discovered that Florida was not an island, but he opened the path to this knowledge.

PONCELET, pôns'lā, **Albert,** Belgium clergyman: b. Liège, 30 Aug. 1861; d. Montpellier, France, 19 Jan. 1912. He was educated at Liège, Tronchiennes and Louvain; entered the Society of Jesus in 1878 and was professor of grammar at Saint Michael's College, Brussels, in 1884–85. In 1886–88 he was assistant editor of ‹Acta Sanctorum› and was ordained to the priesthood in 1891. From 1892 to 1912 he was charged with the practical direction of ‹Analecta Bollandiana› at Brussels. He compiled one volume of ‹Acta sanctorum Belgii› (1911). His works include ‹Anecdota ex codicibus hagiographicis Johannes Gielemans› (1895); ‹Catalogus Codicum Hagiographicorum Latinorum Bibliothecarum Romanorum præter quam Vaticanæ› (1909); ‹Catalogus Codicum Hagiographicorum Latinorum Bibliothecæ Vaticanæ› (1910); ‹Bibliotheca Hagiographica Latina antiquæ et mediæ ætatis› (1911). He edited ‹Annales de l'Abbage de Saint Ghislain par Dom Pierre Bandry et Dom Augustin Durot› (Vols. X, XI, XII, 1897), etc., and contributor to ‹The Catholic Encyclopedia,› ‹Analecta Bollandiana,› ‹Précis historiques,› ‹Archivio della R. Societá Romana di Storia Patria,› *Deutsche Literaturzeitung,* etc.

PONCELET, Jean Victor, French military engineer: b. Metz, 1 July 1788; d. Paris, 23 Dec. 1867. Between the years 1807 and 1810 he attended the Ecole Polytechnique, where he was a pupil of Monge. In 1812 he received the commission of lieutenant in the engineers, but on Napoleon's retreat from Moscow was taken prisoner and transported to Saratov, on the Volga. On returning to Metz in 1814 he worked out the geometrical problems he had begun to consider during his captivity, but these met with little recognition from the French Academy. In 1829 he published his ‹Traité des Propriétés Projectives des Figures.› He henceforth gave himself closely to the study of applied mechanics; invented the water wheel which bears his name and published numerous works on mechanics. In 1835 he was appointed member of the National Defenses Commission and professor of applied mechanics in the University of Paris. He was promoted general in 1848 and went to the Exhibition of 1851 at London as president to the Commission of Mechanics. In 1857 he published his important account of the progress of mechanical science, ‹Collection des Travaux de la Commiss'n Française.› The work which he had begun in captivity in Saratov — ‹Application d'Analyse et de Géometrie› —he published in 1862. He was really the founder of modern geometry and had gained great influence among German mathematicians at a time that his countrymen had accorded him only scant recognition. Among his other works are ‹Les Roues Hydrauliques Verticales› (1826); ‹Experiences Hydrauliques› (1832); ‹Traité de Mécanique Appliquée aux Machines›

(1845); 'Applications d'analy. se et de géométrie' (2 vols., 1862-64), etc. Consult Didion, 'Notice sur la Vie et les Ouvrages du Général Poncelet' (1869).

PONCHO, a kind of cloak worn by the Indian and Spanish inhabitants of South America. It resembles a narrow blanket with a slit in the middle, through which the head passes, so that it hangs down loosely before and behind, leaving the arms free.

POND, Frederick Eugene («Will Wildwood»), American author and journalist: b. Packwaukee, Wis., 8 April 1856. He was educated at Montello, Wis., and early turned to journalism, in which he made sporting matters his specialty and was one of the first to urge the establishment of a National Sportsman's Association. In 1881-86 he was field editor of *Turf, Field and Farm*, edited *Wildwood's Magazine* in 1888-89, and when it was merged with *Turf, Field and Farm,* he became corresponding editor. Since 1897 he has edited the *Sportsman's Review*. From 1893-95 he was secretary of the National Game Protective Association. He has published 'Handbook for Young Sportsmen' (1876); 'Gun Trial and Field Records of America' (1885); 'A Strike' (1897); edited Frank Forrester's works (1879); 'Sportsman's Directory' (1892-93); Hallock's 'An Angler's Reminiscences' (1913) and has contributed to the 'Cyclopedia of American Biography.'

POND, James Burton, American lecture manager: b. Cuba, Allegany County, N. Y., 11 June 1838; d. Jersey City, N. J.. 21 June 1903. His parents settled in Wisconsin in 1847 and there he learned the printer's trade. He edited the *Weekly Journal* of Markesan, Wis., 1860-61, and becoming 2d lieutenant in the 3d Cavalry Volunteers of that State, rose to the rank of major and was among 17 survivors of the guerrilla Quantrell's massacre of a band of 118 soldiers at Baxter Springs, Kan., in October 1863. Between 1865 and 1874 he engaged in business and it was as the manager of the lecture tour of Mrs. Ann Eliza Young, the 19th wife of Brigham Young, when she renounced Mormonism, that he chanced to take up the business of manager and for the rest of his life he continued to «manage» platform speakers. He went to New York in 1879. Among famous men whom he «managed» are Wendell Phillips, William Lloyd Garrison, Robert G. Ingersoll, Henry Ward Beecher, Bill Nye, Max O'Rell and the Dean of Ely, Charles William Stubbs. He published 'Eccentricities of Genius' (1900); 'A Summer in England with Henry Ward Beecher.'

POND, John, English astronomer: b. London, 1767; d. Blackheath, Kent, 7 Sept. 1836. He was educated at Cambridge, traveled extensively and on his return to England in 1798 settled at Westbury, near Bristol, where he engaged in astronomical observations. He erected there an altazimuth instrument, two and a half feet in diameter and by a series of observations proved that the quadrant then in use at Greenwich had changed its form through age, rendering the re-equipment of the Royal Observatory a necessity. He removed to London in 1807, was elected a fellow of the Royal Society and in 1811 was appointed astronomer royal. By means of the six-foot mural circle mounted by the Royal Society in 1812 Pond compiled a catalogue of the north polar distances of 84 stars, which he presented to the society in 1813. In 1821 he substituted the mercury-horizon for the plumb-line and spirit level and in 1825 originated the system of making observations alternately by direct and reflected vision, for further experiments in which direction he was subsequently transferred to Queen's College, Belfast. Though his mathematical knowledge was slight and his work wholly technical, he nevertheless performed valuable services to science and succeeded in introducing modern methods and instruments at the national observatory. He first used two instruments for direct and reflected observations of the same star; invented the method of observing in groups; and was the first astronomer who advocated the practice of depending upon masses of observations for all fundamental data. He was pensioned and retired in 1835. He published a catalogue of 1,113 stars (1833), a work of great value and accuracy. His other publications include the volumes of 'Greenwich Observations,' during his astronomership; various 'Papers' in the 'Transactions' of the Royal and Royal Astronomical Societies; and a translation of the 'Système die Monde' of Laplace.

POND LAW, The, in American politics and legislation an act passed by the Ohio legislature in 1882, for the regulation of the liquor traffic. For eight years the liquor question had agitated Ohio politics and the Republicans finally adopted the Pond Law for the taxation of liquor selling. The law was afterward declared unconstitutional by the Supreme Court of the State.

POND-SKATERS, long, narrow bugs of the hemipterous family *Hydrometridæ* which glide swiftly over the surface of ponds and quiet pools in search of prey. The front pair of legs, comparatively short, serve to seize prey or to cling to a support; while the strong middle and hind legs carry the insect rapidly over the surface, the film bending but not breaking under the feet. The whole body is covered with a velvety fur; and when the insect dives it carries down a jacket of air, upon which it sustains breathing for a considerable time. Consult Howard, 'The Insect Book' (New York 1902). See Fresh-water Insects.

POND SMELT, a small surf smelt, numerous along the shores of Bering Sea and regarded as excellent food.

POND SNAIL, a small fresh-water pulmonate mollusk of the family *Limnæidæ*. In this family the shell is large and thin, the lip sharp, the muzzle short and broad and the eyes are placed at the base of the tentacles. The genera *Limnæa, Physa, Ancylus* and *Planorbis* are prominent. The first-named genus contains the gracefully spiral water-snails with triangular tentacles, numerous in all parts of the world and mostly less than an inch long; a widespread and familiar species (*Limnæa stagnalis*) is often twice that length and the aperture widely flaring. This form is found in streams and pools and crawls upon the leaves and stems of aquatic plants. The equally common genus *Planorbis* possesses a flattened discoidal shell, the whorls of which are coiled round a central axis and lie in one plane. The shell aperture is crescentic in shape, and the foot is round and short. The genus *Physa*, represented all over the United States by *P. heterostropha* (see Snails and Slugs), has the spiral whorls of the shell turned to the left hand; the tentacles are long and slender and the edge of the mantle is fringed.

PONDICHERRY, pŏn-dĭ-shĕr'ĭ (French, Pondichéry, pôṅ-dē-shā-rē), India, the capital of the French possessions in India, on the east or Coromandel coast, 85 miles by rail southwest of Madras. Its territory, with an area of 107 square miles, is surrounded on the land side by the British district of South Arcot. It stands on a sandy beach, and consists of two divisions separated by a canal. The «White Town,» or European quarter, on the east, facing the sea, is regularly laid out, contains a spacious square, in which is the government-house, handsome planted boulevards and a number of well-built houses. The «Black Town,» or native quarter, on the west beyond the canal, consists mainly of huts of brick or earth and a few pagodas. Its streets are broad and shaded by palm-trees, but filthy. The fortifications, formerly strong, were destroyed during the war with the British, and by the Treaty of Paris they are not to be rebuilt nor is Pondicherry to be garrisoned by a native French force. The province is partly watered by the Gingee River, but is not very fertile: some rice, indigo, tobacco, betel, cotton and cocoanuts are raised; which, with cotton cloths and oil seeds, form the chief exports. The imports consist chiefly of manufactured goods. There is no harbor, but only a roadstead, where the surf beats almost as strongly as at Madras. There is, however, an iron pier. The town has been provided with a good supply of drinking water. The settlement was purchased by the French from the Bejapoor rajah in 1672. It was several times taken by the British, the last being in 1803, being restored in 1815. The population of the town in 1916 was 47,398; of the province, 168,344.

PONDOLAND, province of the Cape of Good Hope, a maritime district; area, 3,906 square miles. Its vegetation is luxuriant, and it is well adapted for the rearing of cattle and sheep. The Saint Johns River flows through its southern part, and forms at its mouth an excellent harbor. It was the last part of Kaffraria that remained independent until it became a British protectorate in 1884, and was annexed to the cape in 1894. On 31 May 1910, the colony was merged in the Union of South Africa, thereafter forming an original province of the union. Pop. 234,637.

PONIATOWSKI, pō-nyă-tŏv'skē, the name of an illustrious Polish family descended from an Italian stock. Giuseppe Salinguerra (b. 1612), of the Italian family Torelli, having settled in Poland, took the name of Eziolek, and afterward that of Poniatowski, from the estate of Poniatow belonging to his wife. Among important descendants of his may be cited (1) Stanislas, Count Poniatowski (b. 1678; d. 1762), known for his connection with Charles XII, whom after the battle of Poltava he followed into Turkey, and as whose Ambassador at Constantinople, he had the address to involve the Porte in a war with Russia. He wrote 'Remarques d'un Seigneur Polonais sur l'Histoire de Charles XII par Voltaire' (1741). (2) His eldest son, Stanislas Augustus (b. 1732) was elected king of Poland in 1764. (See Stanislas II). (3) Joseph Antony, nephew of King Stanislas (b. Warsaw, 7 May 1762; d. Leipzig, 19 Oct. 1812). When the Poles attempted in 1794 to drive the Russians out of their country, he joined the Polish camp as a volunteer. Kosciusko gave him the command of a division, at the head of which he distinguished himself at the two sieges of Warsaw. On the creation of the duchy of Warsaw, Poniatowski accepted the place of Minister of War in the new state. In 1809 he commanded the Polish army against the superior Austrian force sent to occupy the duchy, and compelled it to retire. In the war of 1812, against Russia, he was again at the head of the Polish forces, and distinguished himself throughout this campaign. After the battle of Leipzig, during which Nalopeon created him marshal of France, he was ordered (19 October) to cover the retreat of the French army; with a handful of men he protected the retreat till he was twice wounded, and then, being sorely pressed by the enemy on the banks of the Elster River, he spurred his horse into the stream and was drowned. His body was afterward removed to Warsaw, and in 1816 was deposited in the cathedral at Cracow. An equestrian statue of Poniatowski was executed for the city of Warsaw by Thorwaldsen.

PONS ASINORUM, pŏnz ăs-ĭ-nŏ'rŭm («the bridge of asses»), a Latin expression applied early in the 16th century to a diagram showing how to find middle terms to arguments. The original allusion seems to have been the difficulty of getting asses to cross a bridge. The name is also given to the fifth proposition of the first book of Euclid, which sets forth that, if a triangle has two of its sides equal, the angles opposite to these sides are also equal.

PONSARD, François, frăṅ-swă pôṅ-săr, French dramatist: b. Vienne, Dauphiné, 1 June 1814; d. Paris, 13 July 1867. His first venture in literature was made with a translation of Lord Byron's 'Manfred' (1837), and his first success was his 'Lucrèce,' produced in 1843, and welcomed as a return from romanticism to classicism, and when played in 1853, with Rachel in the title rôle, very popular. Among other plays by him are 'Agnes de Méraine' (1846); 'Charlotte Corday' (1850); 'Ulysses' (1852); L'Honneur et l'Argent' (1853); 'La Bourse' (1856); 'What Pleases Womankind' (1860), a trilogy; 'Le Lion amoureux' (1866); 'Galilée' (1867). He became a member of the Academy in 1855. His complete works were issued in 1876.

PONSON DU TERRAIL, pôṅ-sôṅ dü tăr-ă-ē, **Pierre Alexis**, French romancer: b. Montmaur, Isère, France, 8 July 1829; d. Bordeaux, 31 Jan. 1871. He wrote a large number of fictions which were very popular with an uncritical public. Among his works are 'Les Coulisses du Monde' (1853) which established his fame; 'Gown and Sword' (1857); 'The King of Navarre's Mistress' (1863); 'The World's Great Bohemians' (1867); 'Aurora's Amours' (1870).

PONT, Timothy, Scottish geographer, son of Robert Pont: b. about 1560; d. about 1630. He was graduated from Saint Andrew's in

1584, was Minister of Dunnet, Caithnessshire in 1601. In 1609 he subscribed for 2,000 acres of forfeited lands in Ulster and soon after conceived the idea of a Scottish atlas. In pursuance of his plan he visited all portions of Scotland to the most remote and dangerous sections, making his maps on the spot. He died some time between 1625 and 1630 and his maps, which were exceedingly neat and accurate, were ordered by King James to be purchased and published. In the troubleous times following they were forgotten until rescued by Sir John Scott of Scotstarvet, and published in Bleau's ‘Atlas’ (Vol. V, 1668).

PONT-À-MOUSSON, pôṅ'tạ-moo'sôṅ, France, town in the Department of Meurthe-et-Moselle, 16 miles northwest of Nancy, on the Moselle, which divides the town. It contains the Gothic Church of Saint Martin, begun in the 13th century, the town hall, an old convent now used as a petit seminaire, a communal college, blast furnaces and several industrial establishments, including potteries, textile mills, sugar factories, paper and card board mills, cable works, etc. The town was founded about the late 9th century and in 1572–1763 was the seat of a university. It suffered greatly in the Great War of 1914–18, being captured by the Germans early in the war and held by them despite several attempts by the French to retake it. In the autumn of 1918 after the Americans wiped out the Saint Mihiel salient the town was again close to the battle lines. Pop. 14,000. See WAR, EUROPEAN.

PONTA DELGADA, pōn'tä dĕl-gä'dä, or **PONTE DELGADA**, Azores, town on the island of Saint Michael, the largest town in the islands. It is defended on the west side by the castle of Saint Braz, and about three miles to the east by the forts of São Pedro and Rosto de Cão. The principal buildings are churches, monasteries, convents, and an English chapel. The town has been lighted with gas since 1884. The harbor accommodations are good. The trade is considerable, and is chiefly with the British, of whom a considerable number are residents. The chief exports are wheat, maize and oranges; and the imports, cotton and silk goods and hardware. Pop. about 16,179.

PONTANO, pŏṅ-tạ̈'nō, **Giovanni Gioviano**, or **PONTANUS**, **Jovianus**, Italian poet: b. Cerreto, 1426; d. Naples, 1503. He was educated at Perugia and at 22 settled in Naples. There he received a government appointment; became tutor to the sons of Alphonso the Magnanimous; and finally became chancellor. He founded an academy of letters at Naples and was a favorite at court and with the literary men of that capital. For having welcomed Charles VIII of France in 1495 Pontano was in disgrace after the Restoration. He is a figure of political importance in southern Italy but is best known for his poems and dissertations. His Latin is quite pure and his works are of interest in the study of the social life of the period. His chief works are ‘Urania,’ Latin didactic poem in hexameter; ‘De hortis Hesperidum’; ‘De conjugali amore’; ‘Eridanus’; ‘Tumuli’; ‘Naeniæ’; ‘Baiæ.’ His works were published at Venice (5 vols., 1505–18). Consult Ardito, ‘Giovanni Pontano e i suoi tempi’ (Naples 1871) and Symonds, ‘Renaissance in Italy.’

PONTCHARTRAIN, pŏn-chăr-trăn', a lake of Louisiana, about five miles north of New Orleans, about 40 miles long from east to west, and nearly 25 wide. The water is generally from 12 to 14 feet deep. It communicates with Lake Borgne on the east and with Lake Maurepas on the west. It is connected with New Orleans on the south, by Bayou Saint John and a canal, and also by a railroad. It is surrounded by marshes, which have a dense vegetation of water plants. The residential sections, Madisonville and Mandeville, are on the north shore.

PONTEDERIACEÆ, a family of aquatic plants, the pickerel-weeds, which are perennial water of marsh herbs, with perfect, mostly irregular flowers from a one-leafed spathe; perianth corolla-like, equally six-cleft. One genus is *Pontederia*, with one American species (*P. cordata*); another genus is *Heteranthera*, with three species.

PONTEFRACT, or **POMFRET**, England market town and parliamentary borough of Yorkshire, 20 miles south-southwest of York, on the Midland, Lancashire and Yorkshire and Northeastern railroads. It has a grammar and other schools and has extensive agricultural interests. Licorice is a specialty for the manufacture of Pontefract lozenges since 1562. The remains of a Roman camp have been discovered nearby and there are ruins — an old castle in which Richard II died. The water-supply system, cemetery, markets and recreation grounds are owned by the town. Pop. 15,989.

PONTEVEDRA, pōn-tā-va'drä, Philippines, (1) pueblo, province of Negros Occidental, on the western coast on Guimaras Strait at the mouth of the Mangala River, 22 miles south of Bacolod, the provincial capital. It is a military station. Pop. 12,000. (2) Town, province of Cápiz, island of Panay, 12 miles southeast of Cápiz, the provincial capital. Pop. 9,500.

PONTIAC, pŏn'tĭ-ăk, Indian chief: b. on Ottawa River, about 1720; d. Cahokia, Ill., 1769. He became the principal chief of the allied tribes of the Ottawas, Ojibways and Pottawattomies, and it is thought that he led the Ottawas at the defeat of General Braddock (q.v.) near Fort Duquesne. After the taking of Quebec, Major Rogers was despatched to take possession of the western forts for Great Britain, under the terms of the treaty of Paris. Pontiac objected to this procedure, which he regarded as an invasion of his domain, and as a result soon began to plot the complete extermination of the English. In 1762 he sent out messengers who secured the allegiance of all tribes as far as the lower Mississippi in a confederation against the common enemy. The plan, as arranged, was that each tribe was to attack the fort nearest it, and that all were then to make a combined descent upon the undefended settlements. A great pow-wow or council was held. 27 April 1763 near Detroit; Pontiac made a stirring oration, rehearsing the wrongs inflicted upon the Indians by the English. He was himself to make an attempt to capture Detroit on 7 May, but the design was revealed, and Pontiac could lay siege only to the fort. But a long investment was a thing foreign to Indian warfare, and the lines were so loosely drawn that provisions were freely smuggled into the fort. Pontiac was supplied by the Canadians, and paid in promissory notes of birch-bark, later, it is said, scrupulously redeemed. Schooners sent through Lake Erie with supplies and reinforcements were captured by the savages, but at last one with ammunition and provisions did succeed in reaching the fort. The besieged thereupon believed themselves strong enough to venture a sally against the Indian encampment, but Pontiac, warned of the project, defeated them in the battle of Bloody Bridge (31 July). The siege was sustained until 12 October, when Pontiac withdrew his forces to the neighborhood of the Maumee. This part of the conspiracy had, it is true, been a failure; but elsewhere the success was remarkable. When the detached and unorganized character of Indian warfare is considered, recognition must be made of the notable diplomatic and military talent of the chieftain who directed the largest and most powerful coalition in Indian history, and came so near to realizing his grand object. Of 12 fortified posts attacked, eight were taken, while the garrisons of most were massacred; several English expeditions were annihilated; and the frontiers were desolated and terrified. Hostilities continued in a desultory fashion into 1764, but on 17 Aug. 1765 Pontiac formally made peace at Detroit, and in the summer of 1766 concluded a treaty with Sir William Johnson at Oswego, N. Y. In 1769 a Kaskaskia Indian, bribed by an English trader, murdered Pontiac; in vengeance the northern tribes made war on the Illinois group, which was all but exterminated. Consult Parkman, 'The Conspiracy of Pontiac' (1851; new ed. 1898); 'Handbook of American Indians' (Bureau of American Ethnology, Vol. II, 1910).

PONTIAC, Ill., city, county-seat of Livingston County, on the Vermilion River, and on the Illinois Central, the Wabash and the Chicago and Atlantic railroads, about 95 miles north by east of Springfield and 90 miles south by west of Chicago. It was settled about 1825, but was founded permanently in 1829, by colonists from Indiana and Ohio. In 1856 it was incorporated, and received a city charter in 1872. It is in a fertile agricultural region in which stock-raising is given considerable attention. In the vicinity are extensive coal-fields. The chief industrial establishments are candy factories, a hook and eye factory, box factory, and large shoe factories. There is considerable trade in coal, grain, livestock and manufactures. The principal public buildings are the State Reformatory for juvenile offenders, which will accommodate 1,500, the city hall, the public library, and the church and school buildings. Pop. about 6,090.

PONTIAC, Mich., city, county-seat of Oakland County, on the Clinton River, and on the Grand Trunk and the Pontiac, Oxford and Northern railroads, about 26 miles northwest of Detroit. It was settled in 1818–20, incorporated as a village in 1837, and in 1861 was chartered as a city. It was named after the Indian chief Pontiac. It is in a section of beautiful lakes in which there is considerable hunting and fishing. It is surrounded by an agricultural region, and has a number of industries connected with farm and forest products. The chief manufacturing establishments are automobiles and accessories works, farm implement works, foundry products, hardware works, carriage factories, machine shops, flour and lumber mills, knit-goods factory and gas and gasoline engine works. There is considerable trade in farm products, fruit, vegetables, wool and carriages and wagons. It has the State Hospital for the Insane, a library building (ladies' library), a public high school library, public and parish schools and churches. The government of the city is now conducted on the commission plan. The city owns and operates the waterworks. Pop. 17,524.

PONTIAC'S WAR. See COLONIAL WARS IN AMERICA; PONTIAC, and consult 'Handbook of American Indians' (Bureau of American Ethnology, Vol. II, 1910).

PONTIANAK, pŏn-tē-ă-năk', West Borneo, town and capital of the Dutch settlements on the west coast of Borneo; on the Kapuas or Pontianak River, at the mouth of the Landak, in the administrative division of the outports. It is on the equator and 110° 20' E. longitude. It is in a region in which the chief productions are rice, sago, sugar, birds' nests, pepper and wax. Salt, opium, some clothing, wares and machinery are introduced. Pontianak is the chief port of West Borneo, which has an area of 55,825 square miles and population estimated in 1912 at 467,158. It has a Dutch resident. Pop. 10,000.

PONTIFEX, one of the highest priestly colleges at Rome, to which was entrusted the oversight of all religious observances, public or private. Their institution, like that of all important matters of religion, was ascribed to Numa. The number of pontifices was originally probably six, all patricians, exclusive of the king, whose place, after the abolition of the monarchy, was taken by the pontifex maximus, or chief priest. The Ogulnian Law (300 B.C.) raised this number to eight, or, including the pontifex maximus, to nine, five of whom were to be plebeians. Sulla increased the number to 15 and Julius Cæsar to 16, including in both these instances the pontifex maximus. The duty of this dignitary was the inauguration of the priests, and in earlier time the care of the public records (*annales maximi*). He also superintended the sacred rites of Vesta, held his office for life, and could not leave Italy. The emperors afterward assumed this title until the time of Theodosius, and it was subsequently assumed by the Christian bishop of Rome. The pontifices also had the care of the calendar, and decided lawsuits which were connected with religion (hence the *jus pontificum*). The external badge of the pontifex, at least on solemn occasions and while engaged in the duties of his office, was a dress bordered with purple (*toga prætexta*), and a tapering hat made of the skins of sacrificed animals (*galerum*). Consult Bouchè-Leclercq, 'Les Pontifes de l'ancienne Rome' (1871); Mommsen, 'Römisches Staatsrecht' (1887–88); Wissowa, 'Religion und Kultus der Rômer' (1902).

PONTIFICAL ORDERS. See ORDERS, (ROYAL) and DECORATIONS.

PONTIGNY, pôñ-tēn-yē, France, a village on the left bank of the Serein, in the department of Yonne, on the railway between Laroche and Isle-Angely. Its abbey, founded in 1114 by monks from Citeaux, was itself the mother abbey of 43 monasteries. Thomas à Becket, Saint Edmund of Canterbury and Stephen Langdon spent their exile here, and Saint Edmund died and was buried in the monastery, which was devastated by the Huguenots in 1567, and destroyed in the Revolution. The abbatial church (mainly 1150–70) is one of the finest examples of Cistercian architecture. The shrine of Saint Edmund (18th century) in this church was visited by a large number of English Roman Catholics in 1874. Consult Chaillon des Barres, ‹L'Abbaye de Pontigny› (1844).

PONTINE (pŏn'tēn) **MARSHES**, Italy, a swampy plain, 18 to 30 miles long and 6 to 10 miles wide, lying 25 miles southeast of Rome, bounded on the south and west by the Tyrrhenian Sea and sand dunes covered with oaks, and on the east by Monti Lepini. Only a small part of this large area is actually marshy, but enough to make the whole region and much of its surroundings very unhealthy, the marsh vapors being carried to Rome itself by the south wind and being probably the cause of the Roman fever. In the early days of the Roman republic the Volscians possessed the Ager Pometinus, possibly so named from Suessa Pometia, one of its cities, and by elaborate engineering made it habitable and fertile. But the inhabitants of its 33 cities were conquered and driven out by the Romans in 358 B.C., and the land soon became dangerous; even in 312 B.C. its centre was pierced by the great Appian Way built by Appius Claudius. Cethegus attempted to drain the marsh about 160 B.C. Julius Cæsar planned to turn the Tiber into it, but died before the undertaking was commenced. Augustus built several canals, and after him Nerva, Trajan, Theodoric, and 18 popes attempted to better conditions. A law passed in 1899 by the Italian government voted 7,000,000 lire to complete the work, which is estimated to take 24 years. The region has a scanty population of farmers and shepherds, who, however, only spend a part of the year here. Consult Blanchère, ‹La Malaria de Rome et le Drainage antique› (1882); Berti, ‹Paludi Pontiche› (1884); Donat, ‹Die Pontinischen Sümpfe› (1898).

PONTMARTIN, pôṅ'mär'tăṅ, **Armand Ferrand**, Count de, French author: b. Avignon, 1811; d. 1890. He received his education in Paris; became interested in journalism about 1830 and soon became prominent as a critic. He is the author of many novels written in a brilliant style; his best works are ‹Causeries littéraires› (1845–56); ‹Causeries du samedi› (1857–81); ‹Semaines littéraires› (1861–63); ‹Souvenirs d'un vieux critique› (1881–89). Consult his ‹Mémoires› (1885–86).

PONTOON, in military engineering a flat-bottomed boat, or any light and buoyant framework or floating body, used in the construction of a temporary bridge for the passage of troops over a river or arm of the sea. As pontoons form a part of the equipment of any army they must be as light in structure as is consistent with safety. The pontoons used by armies have differed greatly at different times, the two chief types being a kind of undecked boat, and a decked boat or close cylinder. The introduction of pontoons may be considered to date from the 18th century, although long previous to this similar means were used for the passage of streams. Darius passed the Hellespont and Danube by pontoon bridges. In the World War American engineers constructed many pontoons to afford passage across streams where the Germans had wrecked bridges.

PONTORMO, Jacopo Carucci (commonly known as Jacopo da Pontormo), Italian painter: b. Pontormo, near Florence, 1494; d. Florence, 1556. He was a pupil of Andrea del Sarto and painted history and portraits. At 13 he was left an orphan and sent to live at Florence as a pupil of Leonardo da Vinci. He also studied under Pietro di Cosimo and Mariotto Albertinelli. His early work won the approval of both Raphael and Michelangelo, who foretold his future greatness. His pictures are often mistaken for those of Andrea, and the best of them are those produced soon after he had been dismissed from the school of del Sarto who, it is said, had grown jealous of him. He, however, altered his style several times, and took at last to imitating Albert Dürer. His work deteriorated in his latter years and when he admitted the public to see his ‹Deluge› and ‹Last Judgment,› frescoes which he had painted in the chapel of San Lorenzo, in the manner of the imitators of Michelangelo, his work met with such bitter criticism that it was whitewashed over and he is said to have died of mortification. Pontormo remained a master of design to the end of his days, but his coloring, once rich and harmonious, lost all its grace as he neared his three score years. He was a great portrait painter and some of his works in his department have been attributed to Raphael or Andrea del Sarto. His best works are at Florence, but among his finest portraits are ‹A Cardinal› (in the Borghese Palace at Rome); ‹Baccio Bandinelli, the Sculptor› (at Milan); ‹Portrait of a Boy› (in the London National Gallery). There is a fine ‹Holy Family› of his, with life size figures in the Prado Museum, Madrid.

PONTUS, in ancient geography, a country of northeastern Asia Minor, originally the part of Cappadocia lying between Armenia and Colchis and the Halys River; called first Cappadocia on the Pontus (that is, Euxinus, or Black Sea), and then simply Pontus. The country on the east and south is mountainous, but along the coast there are large and fertile plains. A son of the Persian king Darius, Artabazes, received Pontus as a separate satrapy, with the right to transmit it as an inheritance to his posterity. One of his successors, Mithridates (about 400 B.C.), assisted the younger Cyrus, and refused to pay tribute to Artaxerxes. His son, Ariobarzanes I (363–337), made himself independent during the general insurrection of the governors of Asia Minor against Artaxerxes II. Mithridates II (337–302) transferred his kingdom voluntarily to Alexander. Afterward, in the division of his empire in 322, it fell to Antigonus. His successor, Mithridates III (302–266), enlarged his paternal kingdom by conquests, and was succeeded by his son Ariobarzanes III, who reigned from 266 to about 240 B.C., and he again by his son Mithridates IV, whose reign extended to about 190 B.C. He drove back the Gauls, who at various times in the course of the 3d century B.C. invaded Asia Minor, formed settlements there, and attacked Pontus shortly after his accession. Pharnaces I, who succeeded Mithridates IV, and reigned till about 156 B.C., took possession of Sinope, and made it his residence. Mithridates the Great in 124 succeeded his father, in whose time Phrygia had become a part of Pontus. He carried on bloody wars with Rome until his death; at last he submitted to Pompey, and killed himself, 63 B.C., from despair. The western part of Pontus was then annexed to Bithynia, and the remaining parts given away to the chiefs of some of the adjoining states. Pharnaces II, the treacherous son of Mithridates, obtained only Bosporus, and when he attempted to conquer again his paternal kingdom was vanquished by Cæsar, and put to death by Asander, who had made himself king of Bosporus. Still his son Darius received through Antony a part of Pontus. Polemon, who at the same time possessed the kingdom of Bosporus, Asia Minor and Colchis, was his successor. After the death of his widow, Pythodoris, Polemon II succeeded, as king of Pontus, 39 A.D. Nero took Bosporus from him, and Pontus, under the name of Pontus Polemoniacus, became, after Polemon's death, a Roman province. When the Latins in 1204 again conquered Constantinople, Alexius Comnenus founded a new kingdom in Pontus, which remained until Mohammed II united it in 1461 with his great conquests. The most noted town on the coast of Pontus was Trapesus, the modern Trebizond. Consult Clinton, 'Fasti Hellenici' (Vol. III, Appendix); Meyer, 'Geschichte des Königreichs Pontus' (1879).

PONTUS EUXINUS, ūk-sī'nŭs, the ancient name for the Black Sea, still called the Euxine. The name, signifying in Greek "hospitable," is supposed to have been given as a good omen to this dangerous sea.

PONTYPRIDD, pŏnt'ē-prid', Wales, parish market town and urban district of Glamorganshire, also known as Newbridge, 10 miles southeast of Merthyr Tydfil, on the Taff River and on the Glamorgan Canal and the Taff Vale Railway. It has numerous coal mines, iron mines, anchor, cable and chain works, brass and iron foundries, and chemical works. In the middle of the 19th century it was a gathering-place for the followers of the Neo-Druidic cult. Pop. 43,211.

PONY (Lat., *pullanus, pullus*, a young animal), a horse of small breed, usually under 13 hands high. There are several breeds scattered throughout the world. The Shetland, Connemara, Galloway, Dartmoor and Canadian types are best known in northern countries. These horses are extremely hardy and are for their size much stronger than the full-sized horse. The Shetland is the smallest of the types named. In Corsica and Sardinia there are breeds of ponies which have long existed there.

PONY EXPRESS, the mail service between Saint Joseph, Mo., and California inaugurated in 1860. Eight days were allowed for the schedule; 190 stations were established; there were 80 riders and about 400 horses and over 300 station-keepers and their assistants. The service was discontinued in October 1861. Consult article in *Century Magazine*, Vol. XXXIV, New York 1898.

PONZ, pŏnth, **Antonio**, Spanish painter, archæologist and art critic: b. Bexix, Valencia, Spain, 1725; d. Madrid, 4 Dec. 1792. He was educated at the University of Valencia, but, though he made sufficient progress in theology to be able to take the degree of doctor, his tastes diverted him to foreign languages and most strongly to the fine arts; the latter led him to become a pupil of Richart at Valencia. He subsequently lived at Madrid and Rome (1751), but returned to his native land (1760) and received a commission to paint a series of portraits of Spanish authors for the Escorial. Among his published works is 'Viaje de España' (18 vols.), in which he relates his experiences as a commissioner appointed to collect paintings and statuary from suppressed monasteries. The book is full of art criticisms and sketches of Spanish social life of the period. He also wrote 'Viaje fuera de España,' an account of travels through England and France.

PONZA (pŏn'zä) **ISLANDS**, or **PONTINE ISLANDS**, two small groups of volcanic islands on the west coast of Italy, 20 miles from the Gulf of Gaeta and not far from the Pontine Marshes. The larger and more westerly group belongs to the department of Gaeta in the province of Caserta, and consists of: Ponza, off the coast of Naples, which attains at Monte Guarda a height of 900 feet, is four miles long and two-thirds of a mile wide, was the place where Tiberius banished Germanicus' son, where Caligula sent his sisters and Domitian banished Flavia Domitillia; Zanone (Lat. Sinone), further north with a cloister at the summit of its mountain; and Palmarola (Lat. Palmaria), whose rude and wild inhabitants brought upon the island the repute of being the home of the Devil. In the second group are Santo Stefano, the most easterly of the Ponza Islands, and Ventotene (Lat. Pandataria), the place of banishment of Julia, Augustus' daughter, of Octavia (q.v.), Nero's wife, and of Agrippina, wife of Germanicus.

POOD, or **PUD**, a Russian weight of 40 Russian pounds, equivalent to 36 English pounds of avoirdupois.

POODLE. See DOG.

POOK, Samuel Hartt, American naval constructor: b. Brooklyn, N. Y., 17 Jan. 1827; d. Washington, D. C., 30 March 1901. He was graduated from the Portsmouth Academy, New Hampshire, in 1843, and became a shipbuilder, afterward settling in Boston, where as a naval architect he was engaged in building several clipper ships. At the outbreak of the Civil War he entered the government service, superintended the construction of the ironclad *Galena* and assisted in building the *Monitor*. He was appointed assistant naval constructor in the United States service in 1866, promoted naval constructor in 1871, and served in different navy yards until his retirement in 1899.

POOL, Maria Louise, American novelist: b. Rockland, Mass., 20 Aug 1841; d. there, 19 May 1898. For several years she was a contributor to the New York *Evening Post* and was also connected with the New York *Tribune*. She excelled in descriptions of life in New England and among her works are 'In Buncombe County'; 'A Vacation in a Buggy' (1887); 'Tenting at Stony Beach' (1888); 'Rowena in Boston' (1892); 'Mrs. Keats Bradford' (1892); 'In a Dike Shanty' (1896); 'In the First Person' (1898); 'A Golden Sorrow' (1898); 'The Malvon Farm' (posthumous, 1899).

POOL, or POOLING, in commerce and finance, a combination of persons contributing money to be used for the purpose of increasing or depressing the market price of stocks, with a view to the settlement of differences. In pooling railroad interests the common method of dividing the traffic between competing lines, is to pool the receipts and to redistribute them on percentages based upon experience and decided by an arbitrator.

POOL, a game. See BILLIARDS.

POOLE, John, English dramatist: b. England 1786; d. London, 5 Feb. 1879. His success as a dramatist came early in life, and beside his plays he wrote several satirical and humorous books. His dramas were played by the leading actors of the day and were almost invariably successful. His fame, however, rests principally upon the widely popular comedy, 'Paul Pry' (1825), and his farce, 'Twixt Cup and Lip' (1826). Other plays of his that may be named are 'Hamlet Travestie' (1813); 'Who's Who, or the Double Imposture' (1815); 'Deaf as a Post' (1823); 'The Wife's Stratagem' (1827); 'Lodgings for Single Gentlemen' (1829). He also wrote the satirical sketches: 'Little Pedlington and the Pedlingtonians' (1839); 'Comic Miscellany' (1845), etc.

POOLE, Matthew, English compiler: b. York, 1624; d. Amsterdam, 12 October 1679. He studied at Emmanuel College, Cambridge, and took orders, but in 1662 was ejected by the Act of Uniformity from his church of Saint Michaelle-Querne in London, and turned his leisure to good account by spending 10 years on his 'Synopsis Criticorum Biblicorum,' an attempt to condense into one work the opinions of all the biblical critics of all times and countries previous to his own. The work extended to five large folio volumes, and indicates great labor and research as well as no small degree of learning; but it is now of little use, later criticism and research having done much to supersede it. Poole also wrote a defense of the non-conforming clergy (1662); 'The Nullity of the Romish Faith' (1666); 'Annotations upon the Holy Bible' (1683–85), and other works, and took an active part in the leading controversies of his time, especially those with the Socinians and Roman Catholics. The intolerant spirit of the Stuarts compelled him to seek an asylum at Amsterdam.

POOLE, Reginald Lane, English educator and author: b. London, 29 March 1857. He was educated at Oxford and at the University of Leipzig, in 1880–81 was assistant in the department of manuscripts in the British Museum and since its establishment in 1885 has been editor of the *English Historical Review*. He has lectured in modern history at Jesus College, Oxford, since 1886 and is also lecturer on diplomatics in the University of Oxford. He has published 'A History of the Huguenots of the Dispersion' (1880); 'Sebastian Bach' (1882); 'Wycliffe and the Movement for Reform' (1889); edited Wycliffe 'De Civili Dominio Liber I' (1885) and 'De Dominio Divino' (1890); 'Historical Atlas of Modern Europe' (1897–1902); 'John Bales' Index Britanniae Scriptorum' (1902), with Dr. W. Hunt, 'The Political History of England' (12 vols., 1905–10), etc.

POOLE, William Frederick, American librarian: b. Salem, Mass., 24 Dec. 1821; d. Evanston, Ill., 1 March 1894. Graduated from Yale in 1849, he became assistant librarian of the Boston Athenæum in 1851, and in 1852 librarian of the Boston Mercantile Library. From 1859 to 1869 he was librarian of the Athenæum, in 1869–73 of the Cincinnati Public Library, which he organized, and in 1874–87 of the Chicago Public Library, whose formation he also directed. From 1887 he was in charge of the Newberry Library at Chicago, founded by W. L. Newberry. In 1885–87 he was president of the American Library Association, and in 1877 vice-president of the international conference of librarians at London. He was best known for his 'Index to Periodical Literature,' originally begun in 1848, in the preparation of which he was assisted by W. I. Fletcher and many other librarians. His writings, which were very numerous, include 'The Battle of the Dictionaries' (1856); 'Websterian Orthography' (1857); 'Cotton Mather and Salem Witchcraft' (1869); 'Anti-Slavery before 1800' (1887). He also discovered and printed a manuscript of Gov. Thomas Hutchinson on 'The Witchcraft Delusion of 1692,' and reprinted, with introduction and index, the rare work 'Wonder-working Providence of Sion's Saviour in New England.'

POOLE, England, a seaport of Dorsetshire, on the eastern coast of the county, 15 miles west of Bournemouth. There are extensive municipal and harbor improvements, an esplanade, a free library, etc. Ropes, cables, sailcloth, tiles, etc., are manufactured, and there is a large coasting trade principally in clay and grain. Much of the property is owned by the town. Pop. 38,886.

POONA, or PUNA, India, (1) the capital of a district of the Deccan division, Bombay, at the confluence of the Mula and Muta, tributaries of the Bima in a plain nearly 2,000 feet above the sea, 119 miles eastward from Bombay by the Great Indian Peninsula Railway. It is well built and has a European aspect. Its main street is wide and lined with buildings ornamented with paintings and carvings; it has numerous pagodas; the Deccan College for classics, mathematics and philosophy; and a college of science, with special training in civil engineering; a training college for teachers of vernacular and Anglo-vernacular schools, a female normal school, a government first-grade high school, besides other schools; legislative council hall, public library, civil hospital, arsenal and barracks. The European cantonments are on the north, where most of the Europeans reside. In the town are the ruins of the palace (burned in 1827) of the Peishwa or head of the Mahratta confederacy, whose capital was Poona. This station is famed for salubrity, and from July to November is the seat of the Bombay government. It is an important military post, and has some manufactures of silver and gold jewelry, combs, dice and other small articles of ivory, silk and cotton fabrics and articles of brass, copper, iron and clay. Important works supply Poona with water from the Mula Valley, 10 miles above Poona. Pop. 158,856. (2) The district is bounded on the north by the district of Ahmednagar, west by the Ghats, south by Satara and east by the Nizam's dominions. Area, 5,348 square miles. It is an elevated table-land, watered by the Bima and its tributaries, and abounding in isolated heights, formerly crowned with strong fortresses. The villages are mostly open, but sometimes surrounded by hedges of cactus.

POOP-DECK, *in shipbuilding,* a deck raised over the after-part of a spar-deck, sometimes called the *round-house.* Ships formerly had several poops, the one above the other.

POOR, Charles Lane, American astronomer: b. Hackensack, N. J., 18 Jan. 1866. In 1886 he was graduated at the College of the City of New York and in 1892 received the degree of D.Ph. at Johns Hopkins. After 1891 he was successively tutor in mathematics, instructor, associate and associate professor of astronomy at Johns Hopkins. In 1903–10 he was lecturer and professor of astronomy and after 1910 professor of celestial mechanics at Columbia University. In 1901–06 he edited the *Annals* of the New York Academy of Sciences and is author of ‘The Solar System’ (1908); ‘Nautical Science in its Relation to Practical Navigation, together with a Study of the Tides and Tidal Currents’ (1910).

POOR, Enoch, American soldier: b. Andover, Mass., 21 June 1736; d. Hackensack, N. J., 8 Sept. 1780. He engaged as a shipbuilder at Exeter, N. H., until the battle of Lexington, when he raised a regiment of which he was commissioned colonel. He received rank of brigadier-general in 1777, and at Saratoga he performed brilliant service, his brigade leading the advance and bearing a heavy share of the American losses. He joined Washington in Pennsylvania after the surrender of Burgoyne, shared with him the winter at Valley Forge and in 1778 distinguished himself at the battle of Monmouth. He assisted in the campaign against the Six Nations in 1779 and by his able co-operation with General Sullivan gained advantages which resulted in the victory at Newtown. In 1780 at the request of Lafayette he was transferred to the leadership of a brigade of light infantry under his command. Shortly after he contracted the fever from which he died.

POOR, Henry William, American banker and financial expert: b. Bangor, Me., 16 June 1844; d. 13 April 1915. In 1865 he was graduated at Harvard University and three years later entered the brokerage business with his father under the firm name of H. V. and H. W. Poor. In 1890 Mr. Poor became a member of the New York Stock Exchange and was also senior member of the banking firm of H. W. Poor of New York and Boston. In 1868 Mr. Poor issued the first number of the annual which has taken such high rank as a guide to investors, ‘Poor's Manual of Railroads.’

POOR HANDMAIDS OF JESUS CHRIST. See ORDERS, RELIGIOUS.

POOR AND POOR-LAWS. See PAUPERISM.

POOR BROTHERS OF SAINT FRANCIS SERAPHICUS. See ORDERS, RELIGIOUS.

POOR CLARES. See CLARE, SAINT; ORDERS, RELIGIOUS.

POOR DISTRICT. See DISTRICT.

POOR RICHARD'S ALMANAC, an American almanac published by Benjamin Franklin (q.v.) from 1732 to 1757. It was noted for the maxims it contained.

POOR ROBIN, the name of an English almanac which first appeared in 1663. It was published continuously until 1828. The title page bore the inscription «Written by Poor Robin Knight of the Burnt Island; well-wishes to the Mathematics.»

POOR-SOLDIER. See FRIAR-BIRD.

POORE, Benjamin Perley, American journalist: b. Newburyport, Mass., 2 Nov. 1820; d. Washington, D. C., 30 May 1887. Placed by his father in a military school to prepare for West Point he ran away and apprenticed himself to a printer. In 1838 his father purchased for him *The Southern Whig,* which he edited until 1841 when he became an attaché at the United States legation in Belgium. In 1844–48 he was engaged in France in making a collection of historical manuscripts for the State of Massachusetts, and he also traveled extensively in Europe, Egypt and Palestine as correspondent for the Boston *Atlas* in 1843–48. On his return to the United States in 1848 he edited the Boston *Bee* and *Sentinel* until 1854, when he became Washington correspondent for the Boston *Journal* and several other newspapers, a position he occupied for 30 years, with the exception of a brief period as major in the Union army. In 1884 he became clerk of the Senate Committee on Printing Records and edited several publications concerning government affairs. Among his works are ‘Campaign Life of Gen. Zachary Taylor’ (1848); ‘The Rise and Fall of Louis Philippe’ (1848); ‘Early Life of Napoleon Bonaparte’ (1851); ‘The Conspiracy Trial for the Murder of President Lincoln’ (1865); ‘Federal and State Charters’ (2 vols., 1877); ‘The Political Registry and Congressional Directory’ (1878); ‘Life of Burnside’ (1882); ‘A Descriptive Catalogue of the Government Publications of the United States, 1774–1881’ (1885); ‘Reminiscences of Sixty Years in the National Metropolis’ (1886), a compilation of treaties between the United States and foreign governments, etc.

POORE, Henry Rankin, American painter and illustrator: b. Newark, N. J., 21 March 1859. He received his training under Peter Moran and the Pennsylvania Academy of Fine Arts at Philadelphia. Later he studied at the National Academy of Design in New York and under Luminais and Bouguereau in Paris. In 1916 he received a fellowship from the Pennsylvania Academy. He has also been the recipient of the following awards: the first prize of the American Art Association; the second Halgarten Prize of the National Academy of Design; the bronze medal of the Pan-American

Exposition (1901); the silver medal at the Saint Louis Exposition (1904); the gold medal at Buenos Aires (1910); and the silver medal at the Panama Exposition (1915). Poore excels in his artistic grouping of human figures with animals. He has written several valuable books of criticism including 'Pictorial Composition and the Critical Judgment of Pictures' (1903); 'The Pictorial Figure'; 'The Conception of Art'; 'The New Tendency in Art.' Among his best-known pictures are 'Night of the Nativity' (Fine Arts Academy, Buffalo); 'The Shore' (City Museum, Saint Louis); and 'In the Meadow' (Art Association, Indianapolis).

POPAYAN, pō-pä-yän', Columbia, capital city of the department of Cauca, near the left bank of the Rio Cauca, in a plain plentifully watered by that river, 228 miles southwest of Bogota, at the foot of the volcanoes Puracé and Sotara. An episcopal city, Popayan has a college and a seminary for the training of priests. The products of its woolen mills and of the farms of the surrounding country are the main articles of commerce. The city, the first built by Europeans in this region, was founded in 1536 and was nearly destroyed by an earthquake in 1834. Pop. about 8,500.

POPE, the title of the Bishop of Rome, Supreme Pontiff of the Roman Catholic Church. (See PAPACY; TEMPORAL POWER; CATHOLIC CHURCH, ETC.) The following list of Popes has been compiled from the most careful authorities, but the dates up to the 3d century are only approximate, the chronology being very obscure previous to that time:

Peter	41–67
Linus	67–79
Cletus or Anencletus	79–91
Clement I	91–99
Evaristus	99–109
Alexander I	109–116
Sixtus I (Xystus)	116–127
Telesphorus	127–138
Hyginus	138–142
Pius I	142–154
Anicetus	154–165
Soter	165–174
Eleutherus	174–189
Victor I	189–198
Zephyrinus	198–217
Callixtus I	217–222
Urban I	222–230
Pontianus	230–235
Anterus	235–236
Fabianus	236–250
Cornelius	251–253
Lucius I	253–254
Stephen I	254–257
Sixtus II	257–259
Dionysius	259–268
Felix I	269–274
Eutychianus	275–283
Caius	283–296
Marcellinus	296–304
Marcellus	308–309
Eusebius	309 or 310
Miltiades	311–314
Sylvester	314–335
Marcus	336
Julius I	337–352
Liberius	352–366
Damascus I	366–384
Siricius	384–399
Anastasius I	399–401
Innocent I	401–417
Zosimus	417–418
Boniface I	418–422
Celestine I	422–432
Sixtus III	432–440
Leo I	440–461
Hilarius	461–468
Simplicius	468–483
Felix II	483–492
Gelasius I	492–496
Anastasius II	496–498
Symmachus	498–514
Hormisdas	514–523
John I	523–526
Felix IV	526–530
Boniface II	530–532
John II	533–535
Agapetus I	535–536
Silverius	536–537
Virgilius	537–555
Pelagius I	556–561
John III	561–574
Benedict	575–579
Pelagius II	579–590
Gregory I	590–604
Sabinianus	604–606
Boniface III	607–608
Boniface IV	608–615
Deusdedit	615–618
Boniface V	619–625
Honorius I	625–638
Severinus	640
John IV	640–642
Theodorus I	642–649
Martin I	649–653
Eugenius I	654–657
Vitilianus	657–672
Adeodatus	672–676
Donus	676–678
Agatho	678–682
Leo II	682–684
Benedict II	684–685
John V	685–686
Conon	686–687
Sergius I	687–701
John VI	701–705
John VII	705–708
Sisinnius	708
Constantine I	708–715
Gregory II	715–731
Gregory III	731–741
Zacharias	741–752
Stephen II	752
Stephen III	752–757
Paul I	757–767
Constantine II	767–768
Stephen IV	768–772
Adrian I	772–795
Leo III	795–816
Stephen V	816–817
Paschal I	817–824
Eugenius II	824–827
Valentinus	827
Gregory IV	827–844
Sergius II	844–847
Leo IV	847–855
Benedict III	855–858
Nicholas I	858–867
Adrian II	867–872
John VIII	872–882
Martin II	882–884
Adrian III	884–885
Stephen VI	885–891
Formosus	891–896
Boniface VI	896
Stephen VII	896–897
Romanus	897
Theodorus II	897
John IX	898–900
Benedict IV	900–903
Leo V	903
Christopher	903–904
Sergius III	904–911
Anastasius III	911–913
Lando	913–914
John X	914–928
Leo VI	928–929
Stephen VIII	929–931
John XI	931–935
Leo VII	936–939
Stephen IX	939–942
Martin III	942–946
Agapetus II	946–955
John XII	955–963
Leo VIII	963–964
Benedict V	964–965
John XIII	965–972
Benedict VI	973–974
Benedict VII	974–983
John XIV	983–984
Boniface	984–985
John XV	985
John XVI	986–996
Gregory V	996–999
Sylvester II	999–1003
John XVII	1003
John XVIII	1003–09
Sergius IV	1009–12
Benedict VIII	1012–24
John XIX	1024–32
Benedict IX	1033–44
Gregory VI	1045–46
Clement II	1046–48
Damascus II	1048
Leo IX	1049–54
Victor II	1055–57
Stephen X	1057–58
Benedict X	1058–59
Nicholas II	1059–61
Alexander II	1061–73
Gregory VII	1073–85
Victor III	1086–88
Urban II	1088–99
Paschal II	1099–1118
Gelasius II	1118–19
Callixtus II	1119–24
Honorius II	1124–30
Innocent II	1130–43
Celestinus II	1143–44
Lucius II	1144–45
Eugenius III	1145–53
Anastasius IV	1153–54
Adrian IV	1154–59
Alexander III	1159–81
Lucius III	1181–85
Urban III	1185–87
Gregory VIII	1187
Clement III	1188–91
Celestinus III	1191–98
Innocent III	1198–1216
Honorius III	1216–27
Gregory IX	1227–41
Celestinus IV	1241
Innocent IV	1242–54
Alexander IV	1254–61
Urban IV	1261–64
Clement IV	1265–68
Gregory X	1272–76
Innocent V	1276
Adrian V	1276
John XXI	1276–77
Nicholas III	1277–80
Martin IV	1281–85
Honorius IV	1285–87
Nicholas IV	1288–92
Celestinus V	1294
Boniface VIII	1295–1303
Benedict XI	1303–04
Clement V	1305–14
John XXII	1316–34
Benedict XII	1334–42
Clement VI	1342–52
Innocent VI	1352–62
Urban V	1362–70
Gregory XI	1370–78
Urban VI	1378–89
Boniface IX	1389–1404
Innocent VII	1404–06
Gregory XII	1406–09
Alexander V	1409–10
John XXIII	1410–15
Martin V	1417–31
Eugenius IV	1431–47
Nicholas V	1447–55
Callixtus III	1455–58
Pius II	1458–64
Paul II	1464–71
Sixtus IV	1471–84
Innocent VIII	1485–92
Alexander VI	1492–1503
Pius III	1503
Julius II	1503–13
Leo X	1513–21
Adrian VI	1522–23
Clement VII	1523–34
Paul III	1534–49
Julius III	1550–55
Marcellus II	1555
Paul IV	1555–59
Pius IV	1559–65
Pius V	1566–72
Gregory XIII	1572–85
Sixtus V	1585–90
Urban VII	1590
Gregory XIV	1590–91
Innocent IX	1591
Clement VIII	1592–1605
Leo XI	1605
Paul V	1605–21
Gregory XV	1621–23
Urban VIII	1623–44
Innocent X	1644–55
Alexander VII	1655–67
Clement IX	1667–69
Clement X	1670–76
Innocent XI	1676–89
Alexander VIII	1689–91
Innocent XII	1691–1700
Clement XI	1700–21
Innocent XIII	1721–24
Benedict XIII	1724–30
Clement XII	1730–40
Benedict XIV	1740–58
Clement XIII	1758–69
Clement XIV	1769–74
Pius VI	1775–99
Pius VII	1800–23
Leo XII	1823–29
Pius VIII	1829–30
Gregory XVI	1831–46
Pius IX	1846–78
Leo XIII	1878–1903
Pius X	1903–14
Benedict XV	1914

POPE, Albert Augustus, American manufacturer: b. Brookline, Mass., 1843; d. 1909. During the Civil War Mr. Pope served with the 35th Massachusetts Infantry and attained the rank of lieutenant-colonel. After his return to civil life he merchanted shoemaking supplies. He founded the Pope Manufacturing Company in 1877, which secured control of many minor patents; in 1877 also he imported bicycles, but in the next year began to make them. During the «bicycle craze» Pope's company acquired millions. When the automobile had passed the experimental stage Mr. Pope engaged in the manufacture of cars, but was unable to duplicate his success with the bicycle. The company was placed in the hands of a receiver in 1907.

POPE, Alexander, English poet: b. in Lombard street, London, 21 May 1688; d. at Twickenham on the Thames, Middlesex, 30 May 1744. His parents were Roman Catholics. His father, to whom the poet ascribed a not-yet-established connection with the Earls of Downe, was a linen-draper «who dealt in Hollands wholesale»; his mother, Edith Turner, a second wife, was the daughter of William Turner, of Towthorpe, in Yorkshire. About 1700, Pope's father, having prospered in his business, retired to a small property he had purchased at Binfield, in Windsor Forest. Pope was not a strong child. When he was born his parents were no longer young; and from his father he inherited a frail constitution, from his mother a life-long tendency to headache. But he had in his boyhood, and retained through life, a voice like a nightingale. His education was desultory and mostly derived from Romish ecclesiastics. Writing he taught himself by copying type. From his first school at Twyford, near Winchester, he was removed because he had been severely punished for lampooning his master at the tender age of nine. At a subsequent school in London, kept by one Thomas Deane, he learned little; but he gave a taste of his future quality by tacking together an acting play from Ogilby's Homer, in which the school gardener personated Ajax. Leaving Deane, he became the director of his own studies at his home in the Forest. Here it is worth while to let him speak for himself: «When I had done with my priests, I took to reading by myself, for which I had a great eagerness and enthusiasm, especially for poetry; and in a few years I had dipped into a great number of the English, French, Italian, Latin and Greek poets. This I did without any design, but that of pleasing myself: and got the languages, by hunting after the stories in the several poets I read; rather than read the books to get the languages. I followed everywhere as my fancy led me, and was like a boy gathering flowers in the fields and woods, just as they fall in his way. These five or six years I still look upon as the happiest part of my life.» (Spence's ‹Anecdotes,› by Singer, 1820, p. 193).

To this self-education his biographers have, with reason, attributed some of the peculiarities of his character and genius. His unremitting application no doubt injured his health and tended to make his life the «long disease» he afterward called it. Its enforced seclusion, coupled with the disabilities to which Papists were then exposed, fostered some of that — to give it its mildest name — disingenuousness, which came to be one of his worst faults. On the other hand, his natural parts were so keen, and his critical faculty so early matured, that it may be doubted whether any more liberal training would have better equipped him for what he afterward achieved. He is an excellent illustration of Boswell's dictum about the superior flavor of animals who «feed excursively» as contrasted with those who are «cooped up.» One result of his course of study was that he began early to versify, or, as he puts it, «lisp in numbers.» His first dramatic essay has already been referred to, and he is said to have composed another on the Legend of Saint Genevieve. A third effort was an epic on Alcander, Prince of Rhodes, being four books of 1,000 lines each on the Dryden pattern, which opened under water in the Archipelago with a description of the Court of Neptune. By his own account this must have been a medley of many notes. «There was Milton's style in one part, and Cowley's in another; here the style of Spenser imitated, and there of Statius; here Homer and Virgil, and there Ovid and Claudian» (Ib. pp. 24, 277, 279). ‹Alcander› he afterward burned; but detached couplets found their way into later works. He also translated part of Ovid's ‹Metamorphoses,› of Statius, and Cicero de Senectute. His chief adviser was his father, who criticised his «rhymes,» and ruthlessly «sent him down» when he did not think them good enough. The Alcander epic occupied him from 13 to 15 (Ib. p. 279), when he went to London to learn French and Italian. His education was completed by much study of Temple and Locke, of Rapin and Bossu, and of Dryden's «Prefaces.»

Already, while living at Binfield, he had made friends who served to influence his tastes. One was the old scholar and diplomatist, Sir William Trumbull of Easthampstead Park, who advised him to translate Homer; another, the wit and man of fashion, Henry Cromwell; a third, the veteran dramatist Wycherley, who was foolish enough to submit his senile poetical effusions to the criticisms of his sharp-eyed junior, a circumstance which has generally been held to have brought about a cooling of their friendship, although the manipulation of Pope's correspondence has not made it an easy matter to understand the actual attitude of affairs (Courthope's Life, pp. 73, 387–407). By Wycherley Pope was introduced to William Walsh of Abberley, in Worcestershire, the critic and minor poet, who enjoined his young friend to make correctness his «study and aim» (Spence, p. 280), in other words, «to study not only accuracy of expression,» but also «propriety of design and justice of thought and taste» (Courthope's Life, p. 25). It has been shrewdly suggested that in all probability Pope's native bias to these things suggested the judicious counsels of the critic whom Pope afterward styles «knowing Walsh.» Other literary luminaries with whom he became acquainted at this period were Garth of ‹The Dispensary,› Congreve, and Lord Lansdowne.

Pope's first important publication was his ‹Pastorals› (1709). After the 18th century fashion, these were much circulated in manuscript, and they were already well known to most of the contemporary literati long before they were printed. They appeared at the beginning of the sixth volume of Tonson's ‹Poetical Miscellanies› (which also included a modernization by Pope of January and May, Chaucer's ‹Merchant's Tale›); and exhibiting, as Johnson says, «a series of versification which had in English poetry no precedent,» met with complete success. Two years later appeared the ‹Essay on Criticism,› said to have been written in the year in which the ‹Pastorals› were printed. In this poem Pope aimed at occupying much the same place in English as

Horace had occupied in Latin with the ‘Ars Poetica,’ and Boileau in French with the ‘Art Poétique’; and the performance, though of necessity a *cento,* was certainly an extraordinary one for a youth of three and twenty. Addison, who noticed it in *Spectator,* No. 253, certainly did not “damn it with faint praise” when he called it “a masterpiece in its kind,” which contained things that “would have been very much admired in an Ancient Poet,” though he regretted the freedom with which the writer already spoke of his brother moderns. But the commendation shows how closely Pope had followed the injunctions of Walsh; and moreover, fully justified him in offering to Steele's and Addison's paper (No. 378), his next effort, the ‘Messiah,’ a sacred Eclogue modeled on the ‘Pollio’ of Virgil. By this time his style was formed, and his metrical skill developed to an extraordinary point of excellence. Nothing was wanting but a theme suited to his peculiar gifts.

This theme he found in a little piece which, as a matter of fact, in its first form, preceded the ‘Messiah,’ namely the hero-comic ‘Rape of the Lock,’ contributed in May 1712, to another ‘Poetical Miscellany,’ that of Bernard Lintot. It is a flawless piece of executive jewel-work, the fragile theme of which is the theft of a lock of hair by Lord Petre, a Roman Catholic peer, from a noted beauty, Miss Arabella Fermor. Out of this trifling amatory escapade had arisen a family estrangement, which Pope was invited to reconcile by his rhymes. His poem was more successful than his purpose. Upon this he extended his plan, and improved it. Not content with the “let well alone” of Addison, who called it “*merum sal,*—a delicious little thing,” Pope proceeded to weave skilfully into his first sketch a subordinate Rosicrucian machinery of sylphs and gnomes, which eventually proved the best part of what Johnson justly describes as “the most airy, the most ingenious, and the most delightful of all his compositions.”

He was now launched, and his future popularity assured. His next works were ‘Windsor Forest,’ of which he borrowed the design from Denham's ‘Cooper Hill’; and the ‘Ode for Music on Saint Cecilia's Day,’ a competition with Dryden suggested by Steele. Both these came out in 1713. In 1715, following the ‘Lock’ in its extended form (1714) and another imitation of Chaucer, ‘The Wife of Bath,’ came a second modernization from the same source the longer ‘Temple of Fame.’ But the great event of 1715 was the publication in June of the first four books of the translation of the ‘Iliad.’ Proposals for this had been issued in 1713, and the generous advocacy of a new friend, Swift, had largely swelled the subscription list. The task progressed until, in 1720, the Iliad was completed in six quarto volumes, dedicated to Congreve. Then came the ‘Odyssey,’ in which the poet was assisted by two subordinate “hands,” William Broome, 1683–1745, and Elijah Fenton (1683–1730). By these two works Pope must have cleared from £8,000 to £9,000. But though he subsequently boasted, that, thanks to Homer, “he was indebted to no prince or peer alive,” it is only just to recall the fact that while he was right in contending that no bounty was involved, his subscription list would have been considerably contracted if his patrician supporters were withdrawn. For this famous paraphrase itself, it must be admitted that its fame has somewhat — perhaps too much — faded at the present time. It may be that, in Gibbon's epigram, “it is a portrait with every merit but that of faithfulness to the original,” — it may be that, as Bentley said “it is a pretty poem, which must not be called Homer”; but it is at least a triumph of uniform versification, and a surpassing example of sustained achievement. In that full-wigged Age of Anne, for the meridian of which it was expressly calculated, it bulks largest of the poetical output; and its influence extended far beyond its period of production. No one has written more indulgently of it than one of Pope's modern rivals, Professor Conington: “It has been — I hope it is still — the delight of every intelligent schoolboy; they read ‘of kings and heroes and of mighty deeds’ in language which, in its calm, majestic flow, unhasting, unresting, carries them on as irresistibly as Homer's own could do, were they born readers of Greek; and their minds are filled with a conception of the heroic age, not indeed strictly true, but almost as near the truth as that which was entertained by Virgil himself.” (‘Misc. Writings,’ 1872, i. 43.)

A minor incident connected with the ‘Iliad’ was the misunderstanding between the translator and his first critic, Addison, to which it gave rise. Pope's frailty of constitution led him easily to magnify mole hills, and his literary suceptibilities were painfully morbid. His relations, moreover, with Addison had already become strained. Addison, as we have seen, had deprecated that recasting of ‘The Rape of the Lock,’ which subsequently proved so fortunate. Pope's suspicious nature resented this advice, especially in view of the result. When again Pope championed Addison against the rancorous old critic, John Dennis, Addison had not approved — he could hardly be expected to approve — the peculiarly Swiftian character of Pope's warfare. Finally, by an unfortunate coincidence, when Pope's ‘Iliad’ was announced, a rival version was put forward by Addison's bosom friend, Thomas Tickell (1686–1740), which Pope perhaps not unnaturally regarded as prompted, if not edited, by Addison himself. Modern criticism has failed to find any valid ground for this supposition. But the cumulative result of Pope's irritation was the cruelly clever portrait of Addison as “Atticus” which 18 years after Addison's death, found its final place in the Prologue to the Satires (“Epistle to Arbuthnot”). Upon the faith of Spence's ‘Anecdotes,’ pp. 148–149, it was long held that Pope, in his first anger, had actually sent the lines to Addison; but this is now held not to be probable (Courthope's ‘Life,’ 1889, p. 161); and Spence's entire account is conjectured to be a fabrication by Pope arising out of his desire to establish beyond a doubt the fact that the character was not written after the death, but during the life of Addison. In any case, the “Atticus” is a matchless piece of writing, and (as even Addisonians must allow), in some particulars, presents — to quote Thackeray on Dennis portrait of Steele — “a dreadful resemblance to the original.”

After the already-mentioned ‘Temple of Fame,’ Pope's published works were the ‘Elegy to the Memory of an Unfortunate Lady,' a poem probably idealized from the story of a Mrs. Weston of Sutton, whose relations with her husband had not been of the happiest (Courthope, 133); the 'Epistle of Eloisa to Abelard,' which is supposed to owe something of its passionate rhetorical imagery to the feelings entertained at this date by the writer for Lady Mary Wortley Montagu; and, in collaboration with Gay and Arbuthnot, the dramatic skit upon Dennis and others entitled 'Three Hours after Marriage' which ignominously failed at Drury Lane in 1717, to which year the pieces above mentioned also belong. In 1725, appeared an edition of Shakespeare in six quarto volumes which has no more authority than that of Johnson. Then, in May 1728, came the first edition of *The Dunciad*, Pope's famous onslaught upon those swarming hacks and poetasters of the day, whom his heated imagination exaggerated into an army of personal enemies. In 1729 followed a more perfect edition with a dedication to Swift. Other issues succeeded; and, in 1742, was added a fourth book directed against dunces theologic and scientific. The scheme of the poem describes the elevation, with fitting ceremonial, of Lewis Theobald (who had earned Pope's hatred by certain merited strictures on his Shakespeare) to the throne of Dulness, then vacant by the death of Dryden's 'Mac Flecknoe' Shadwell,—

"without dispute
Through all the realms of Nonsense absolute."

In 1742 Pope gratified a new antipathy by substituting Colley Cibber for Theobald, a change which can scarcely be said to have been an improvement. The Epos of the Dunces remains nevertheless a magnificent satire upon a subject which is not worthy of the powers it called forth, though it is perhaps the culminating example of the combative gifts of its author. Ruskin goes even so far as to call it «the most absolutely chiselled and monumental work 'exacted' in our country» (Lectures on Art, 1870, p. 70).

Swift has the credit of eventually prompting the 'Dunciad.' Pope's next effort, the 'Essay on Man,' is inscribed to another «guide, philosopher and friend,» Bolingbroke. «One truth is clear, Whatever is, is right»— which is the last line of the first of its four epistles, might be described as the keynote of his attempt «to vindicate the ways of God to Man.» The writer's metrical dexterity, his power of crystallizing precept, and his executive skill generally, were never shown to greater advantage than in this work; but the consensus of criticism has come to the conclusion that he was not in complete sympathy with, if indeed he thoroughly comprehended, the philosophical tenets of the meteoric genius whom he terms «the master of the poet and the song.» Hence critics like the late Sir Leslie Stephen have come to describe the arguments as «confused, contradictory, and often childish.» Yet, although the poem labors under these disadvantages, and although, moreover, it is only part of an unfinished whole, it had an extraordinary popularity with its first public, and also on the Continent, where, in its translated form, it must have made its appeal by its matter rather than its manner.

To Bolingbroke also Pope owed what must ever be regarded as his greatest and most personal performances, his 'Moral Essays' and his 'Satires and Epistles.' The 'Moral Essays' appeared from 1720 to 1735; the 'Satires and Epistles' from 1733 to 1738. These last are unrivaled in their pungent criticism and portraiture of contemporary character and manners. «It is no paradox,» said the late Rector of Lincoln College, Mark Pattison, «to say that these 'Imitations' are among the most original of Pope's writings. So entirely do they breathe the spirit of the age and country in which they were written that they can be read without reference to their Latin model» (Preface to 'Satires and Epistles').

The discussion of Pope's untiring literary labors has left his life somewhat in the background. In April 1716, not long after the appearance of the first instalment of his Homer he moved from Binfield to Chiswick, where he lived in what is now known as Mawson's Row. In 1717 his works had become numerous enough to fill a handsome folio volume which was issued by Tonson and Lintot, with its author's portrait engraved by George Vertue after Charles Jervas. In October of the same year his father died; and he moved with his mother to a little villa at Twickenham in which he thenceforth resided, «twisting and twirling and rhyming and harmonizing» five acres of garden until it became «two or three sweet little lawns, opening into one another and surrounded with impenetrable woods.» Here he received his friends, among others the Joseph Spence, to whom we owe the bulk of our Popiana. In 1733 his mother, to whom he had always shown an exquisite filial affection, and whom he tended lovingly to the last, died at an advanced age. Ten years later he himself was passing away. prematurely old, and worn out with asthma and dropsy, though scarcely 55. To the end he continued to «dispense his morality» (in the form of his Ethic epistles), and to revise and rearrange his other poems. Finally he died at Twickenham, 30 May 1744, and was buried in the middle isle of the parish church, where 17 years later a monument was erected to him by his literary executor, Bishop Warburton. In 1730 Gilliver had published a second volume of his poems, and in 1737–41 had appeared two corresponding volumes of his letters, etc. The story of these last,— of the artifices employed to secure their publication, of their manipulation and readjustment to suit the writer's own views would take too long to tell here. But the subject has been amply discussed in Dilke's 'Papers of a Critic,' 1875, in the «Introduction to Pope's Correspondence» (Vol. VI, 1871) of Elwin and Courthope's 'Works,' and in Courthope's 'Life' (1889).

Pope was never married. At one period of his career he had cherished a passion for the brilliant Lady Mary Wortley Montagu, by whom he was encouraged and scorned, treatment for which he took his revenge fiercely in subsequent satires. But his greatest feminine friend was Miss Martha Blount of Mapledurham, an old acquaintance of the Binfield days, with whom he renewed his relations at Chiswick and Twickenham, and whose friendship he retained at the close of his life. He had spent three or four hours a day with her for 15 years, he said in 1730; and the companionship, which was prolonged for nearly 15 years more, seems always to have had a cheering effect upon his drooping and variable spirits. Into the tangle of gossip which has gathered about this connection, memorable among literary alliances, it is profitless to enter. But that Pope was devotedly attached to his blue-eyed goddess there can be no manner of doubt.

Pope's character is so intimately connected with his personality that it is impossible to omit here some description of his habits and appearance. Though amiable and attractive in childhood, his sedentary life and close application in early youth speedily affected a constitution not radically sound at the outset. He was remarkably frail and small (four feet six), and he rapidly became deformed. As already stated he was a martyr to headaches. In his diet he required to exercise the greatest caution; and he suffered cruelly from any deviation from his régime. He was intensely susceptible to changes of temperature and climate. In his earlier days he was able to take horse exercise; but in his manhood he could not dress himself without help, nor could he come abroad without being wadded with furs and stiffened with buckram. That these things reacted upon his views of life can scarcely be contested. «He was the most irritable of the irritable race,» says one contemporary; *Mens curva in corpore curvo,* says another. «He played the politician about cabbages and turnips,» says a third. *Per contra,* it must be remembered that, however sensitive, artificial and vindictive, he was a devoted son and an attached friend. And at least he was a genuine *litterateur.*

As a poet his general position is easy to define. He was not a great lyrist; he was not a profound thinker; but he is a supreme artificer. Borrowing the heroic couplet from Dryden, he brought it, as the medium for didactic and satirical verse, to a pitch of perfection which has never been surpassed, though it has sometimes been made monotonous by imitation. He could not, as we have implied, originate; but he could decorate to any extent. Granted the theme, he could develop it; he could embroider it supremely; he could lend it every advantage in the way of condensed perspicuous and epigrammatic exposition. The major part of his work is a triumphant exemplification of Addison's dictum that «Wit and fine Writing doth not consist so much in advancing Things that are new, as in giving Things that are known an agreeable Turn.» This was Pope's chief function. With inspiration, with the unattempted or unimagined in poetry, he had small concern. But he could express, in a given metrical form, and with faultless lucidity and finish, the best floating ideas in circulation at the time of writing. His gifts of wit and irony led him inevitably in the direction of the satire; and his high-water mark is his 'Epistle to Arbuthnot,' which exhibits his varied and exceptional powers in their fullest diversity.

Bibliography.— There are several early lives of Pope of which that by Johnson ('Poets,' London 1781) is the most important. Of later efforts, the most notable are Carruthers (1853–57); Sir Leslie Stephen (1880); Courthope (1889). Of Pope's 'Works' there are editions by Warburton (1751); Warton (1797); Bowles (1806), and Roscoe (1824); but all these give place to the 10 volume edition by Elwin and Courthope (1871–89). Good editions of the poems alone are 'The Cambridge Edition,' edited by H. W. Boynton (Boston 1903); that edited with memoir by J. Dennis (London 1891) and the 'Globe Edition' (New York 1899). Consult Spence's 'Anecdotes,' by Singer (1820); Dilke's 'Papers of a Critic' (above mentioned); Mark Pattison, 'Essay on Man' (1869), and 'Satires and Epistles' (1872); Conington (above mentioned); Abbot's 'Concordance' (London 1875), and Montégut in *Revue des deux Mondes* (March 1888 for Pope's influence abroad. Consult also Dennis, John, 'The Age of Pope, 1700–1744' (London 1894); Chesterton, G. K., 'Varied Types' (New York 1903); Symonds, E. M., 'Mr. Pope: His Life and Times' (ib. 1909).

AUSTIN DOBSON,
Author of 'Life of Goldsmith,' 'Life of Richardson,' etc.

POPE, Charles A., American surgeon: b. Huntsville, Ala., 1818; d. 1870. He received his education at the Cincinnati Medical College and at the University of Pennsylvania. From 1843 to 1847, Dr. Pope was professor of anatomy and physiology at Saint Louis University; from 1847 to 1853 professor of surgery and from 1848 to 1853 dean at the same institution. From 1853 to 1867 he held the chair of surgery at the Saint Louis Medical College, the medical department of Washington University. He was president of the American Medical Association in 1854 and after 1867 lived in Paris.

POPE, Franklin Leonard, American electrician: b. Great Barrington, Mass., 2 Dec. 1840; d. there, 13 Oct. 1895. He was a telegraph operator in 1857, assistant engineer of the American Telegraph Company in 1862 and in 1864 while holding a similar position in the Russo-American Company made the first survey of the territory between British Columbia and Alaska. Later with Edison he invented the stock exchange «ticker,» in 1872. He invented the rail circuit for automatically controlling electric block signals, was editor of the *Electrical Engineer,* 1884–95; and president of the American Institute of Electrical Engineers in 1885. He published 'Modern Practice of the Electric Telegraph' (1871) and 'Life and Work of Joseph Henry' (1879).

POPE, John, American soldier: b. Louisville, Ky., 16 March 1822; d. Sandusky, Ohio, 23 Sept. 1892. He was graduated from the United States Military Academy in 1842, was assigned to the topographical engineers, served in Florida in 1842–44, in 1846 entered the United States Army in Mexico during its advance on Monterey, was brevetted captain, and in 1849 conducted the exploring expedition which opened up Minnesota and demonstrated the navigability of the Red River of the North. In 1853 he was in New Mexico, employed in surveys for the projected Pacific Railway; and in 1854–59 explored the plains and the Rocky Mountains, being the first to experiment in the irrigation of arid western tracts by means of artesian wells. After his return from these duties, he criticized the policy of President Buchanan in a lecture delivered at Cincinnati in February 1861 and for this action was summoned to a court-martial. The trial was, however, dropped. Made brigadier of volunteers in May 1861, he was assigned to command in Missouri, quickly organized at Commerce, Mo., an army of about 12,000 and in March 1862 effected the capture of New Madrid and Island No. 10. He was promoted major-general of volunteers and made brigadier-general in the regular army. He was then placed in command of the Army of Virginia and fought the battles of Cedar Mountain and the second Bull Run. In the latter he was badly worsted by «Stonewall» Jackson (q.v.) and on his return to Washington requested to be relieved from his command. He was thereupon transferred to the Department of the Northwest, where he directed a campaign against the Sioux; and in 1865 was appointed to the command of the military division of the Missouri; subsequently made the Department of the Missouri. Later he was in command of various military districts, of the Department of the Lakes and that of the Pacific and in March 1866 was retired with rank of major-general. From his defeat in the second battle of Bull Run developed the trial, conviction and subsequent restoration of Gen. Fitz John Porter (q.v.). He published 'Explorations from the Red River to the Rio Grande' (in 'Pacific Railroad Reports' vol. III); and 'The Campaign of Virginia, of July and August 1862' (1865).

POPE, John Henry, Canadian statesman: b. Eastern Township, province of Quebec, 1824; d. 1889. He received his education at the Compton High School; took an active interest in Conservative politics after 1857 and after 1867 represented Compton County in the Canadian Assembly. In 1871-73 Pope became Minister of Agriculture in Sir John A. Macdonald's first Cabinet and held the same office in that premier's second Cabinet from 1878 to 1885. After 1885 Pope was Minister of Railways and Canals. With Tupper and Macdonald he negotiated the contract for the construction of the Canadian Pacific Railroad which was later approved by the Dominion Parliament.

POPE, John Russell, American architect: b. New York, 24 April 1874. He was educated at the College of the City New York, and in 1894 was graduated at the School of Mines of Columbia University. In 1895 he was Fellow of the American Academy in Rome, and in 1896-97 held the Schermerhorn traveling fellowship in architecture. In 1900 Mr. Pope attended the École des Beaux Arts, Paris, since when he has practised in New York. His principal works are the Scottish Rite Temple, Washington; Plattsburg (N. Y.) City Hall; McDonough Memorial, Plattsburg; Lincoln Memorial, Hodgenville, Ky.; the Terminal Station, Richmond, Va.; residences of Mrs. W. K. Vanderbilt, Jr., Ogden B. Mills, Mrs. Arthur Scott Burden, Levi P. Morton, John R. McLean, Henry White and Mrs. R. S. Hitt, Washington, etc., and memorial tomb of William B. Leeds, New York. in 1916 Mr. Pope was awarded the Architectural League medal of honor in architecture and in 1919 was elected associate of the National Academy of Design.

POPE, William Burt, Methodist theologian: b. Horton, Nova Scotia, 1822; d. 1903. He received his education at Richmond College, London, and from 1841 to 1867 held pastorates in England, after which he held the chair of theology at Didsbury College, Manchester. He published 'Discourses on the Kingdom and Reign of Christ' (1869); 'The Person of Christ' (1875; 3d ed., 1899); 'Christian Theology' (2d ed., 3 vols., 1877-80); 'The Prayers of St. Paul' (1876); 'Sermons and Addresses' (1878); 'A Higher Catechism of Theology' (1883). Consult Moss, R. W., 'The Life of W. B. Pope, Theologian and Saint' (London 1912).

POPERINGHE, pōp'răng, Belgium, town in the province of West Flanders, about four miles from the French frontier and five miles west of Ypres, with which it is connected by rail. It is an ancient town and in the 14th century was a rival of Ypres. Nearby were great hop gardens, tanneries and bleaching grounds. Most of the city's ancient landmarks were obliterated during the War of 1914-18 in the exceptionally severe fighting in Ypres and its neighborhood. Laces, linens and woolens were manufactured in considerable quantities previous to the war, when the population totaled 12,205.

POPHAM, pŏp'ăm, **George**, English colonist: b. Somersetshire, about 1550; d. 1608. Becoming a partner of Gorges in projecting the colonization of Maine, he collected 120 men and sailed from Plymouth in 1607 with two vessels and arrived in August of that year at the estuary of the Kennebec. There he erected a small fort and storehouse and named the place Fort Saint George. He was chosen president of the colony, the first English settlement in New England, but his death in the following year and the severity of the winters disheartened his followers who soon after his death abandoned the colony and returned to England.

POPHAM, Sir John, English jurist: b. Wellington, Somerset, 1531; d. 10 June 1607. He was educated at Oxford, studied in the Middle Temple and became sergeant at law in 1571. After having been speaker of the House of Commons in 1581 and Attorney-General in 1585 he was made lord chief justice in 1592 and held this post 15 years. He was a brother of George Popham, and in 1607 was associated with him and Sir Fernando Gorges in establishing the Popham colony in what is now the State of Maine, the three holding a patent to an extensive tract of territory in that region.

POPINJAY, a parrot; a figure of a bird formerly put up as a mark for archers to shoot at. The green woodpecker is also so-called in provincial parts of Great Britain.

POPISH PLOT. See OATES, TITUS.

POPLAR, England, a metropolitan and Parliamentary borough of London, on the Thames between Limehouse Reach and Blackwall Reach. Area, 2,328 acres. The district is poor, overcrowded and depressing, with a high deathrate and containing the largest proportion of paupers in London, the latter being 43, four per 1,000 at Christmas 1913. Blackwall and the Isle of Dogs are in the borough, and the docks — East and West India and Millwall — afford employment to the laboring population. Engineering, shipbuilding and chemicals are the chief industries. The metropolitan borough includes the Bow and Bromley and the Poplar divisions of Tower Hamlets, each returning one member. Pop. about 162,442. Consult Cowper, 'Descriptive Account of Millwall' (1853);

Forrow, 'The Thames and Its Docks' (1877); Simmonds, 'History of Poplar' (1870), and the publications of the committee for the survey of Greater London.

POPLAR, a genus (*Populus*) of trees of the family *Salicaceæ* which includes only one other genus, *Salix*, the willows. The species, which probably do not exceed 25, are widely distributed in the Northern hemisphere from sub-tropical regions to the limits of vegetation both in latitude and altitude. Half of them are American. They are mostly of small or medium size, quick growth and short duration; bear deciduous, broad, heart-shaped or lozenge-shaped leaves on long slender petioles; diœcious, naked flowers usually in pendulous catkins which appear before the leaves; and small two- to four-celled fruits (capsules) filled with cottony seeds. Their wood is generally soft, light and white. It is little used for timber or lumber; but it is an important fuel wood in regions such as the Western States, where fuel is scarce and costly. The trees are often planted for this purpose and for windbreaks, their rapid growth being in their favor. They are also favorites for copses and for pollarding (q.v.). The lumber called poplar is generally that of another tree,— the whitewood or tulip tree (q.v.). Poplars are used in enormous quantities for making wood-pulp paper, carboard, etc., especially in Ontario, Quebec and the New England States, where hundreds of acres of forest are cut for this purpose annually. As ornamental trees they are frequently planted to excess at summer resorts because they quickly make an effect. In such cases they give an air of cheapness to the place not observable where maples, oaks, etc., are prevalent. The latter should always be planted with poplars, in order to replace them.

Poplars are as easily propagated from cuttings as currants or willows; in some cases the switches need only be stuck in moist ground. The choice horticultural varieties, especially the weeping kinds, are grafted. Suckers may be used, but since their removal generally induces the growth of many more suckers, this method must be practised with caution except where the ground is not valuable. The species will succeed in a great variety of soils from sand to clay, and in almost any situation, even in crevices on rocky mountain slopes. Some of them, however, especially the cottonwood, seem to thrive best in low alluvial land upon the margins of streams.

The best-known species are probably the following: The Lombardy poplar (*P. nigra*, var. *italica*, also called *P. pyramidalis, P. italica, P. fastigiata*, etc.) is probably a native of Asia, whence it has spread to the Mediterranean region and thence to temperate countries throughout the world. It is noted for its erect instead of spreading habit, which makes it a striking specimen in ornamental plantings. It grows very rapidly, attains a height of 100 to 150 feet, but is not long-lived in the coldest States and most of Canada. It is one of the worst species to produce suckers; hence it should not be planted where the soil will be disturbed by cultivation.

The black poplar (*P. nigra*) is a native of northern Asia and Europe, and is occasionally seen as an escape in America east of the Mississippi River. It is of rather pyramidal habit, less erect, however, than its variety the Lombardy, and of darker colored foliage and slower growth than the cottonwood. It seldom exceeds 100 feet in height. The down from its seeds has been used for paper, hat and cloth-making in France, but the industry has been abandoned as unremunerative. The wood, which is not prone to shrink and swell, is used for turning, cabinet-making, toys, flooring, doors, etc.

The Carolina poplar (*P. deltoides*) is an American species well known from New Brunswick to the Rocky Mountains and southward to the Gulf States. It is the largest of the genus, specimens sometimes attaining 150 feet in height and more than six feet in diameter. It is also one of the most valuable, its timber being considered useful for nearly all the purposes mentioned. It is also more highly prized for ornamental planting than any other species, since it not only succeeds well in all soils, but possesses qualities of stability and strength lacking in other species. Its bright, glossy foliage, constantly in motion, adds cheeriness and life to plantations as few other trees can. It is one of the most popularly planted species in the Western States, not only for shelter and for fuel but for timber and lumber. In Europe it is often called the Canadian or Italian poplar. It has several horticultural varieties, among which a striking form is the golden-leaved *P. vangeertii*, which is one of the choicest of yellow-leaved trees.

The balsam-poplar or tacamahac (*P. balsamifera*) is indigenous from Newfoundland to British Columbia and extends well into Siberia, its southern limits, except in the mountains, being about Pennsylvania. Its erect growth resembles the Lombardy poplar, but it is slower in growth, more rugged and hardy. The type species and its three well-marked botanical varieties exceed the cottonwood in variability. A closely related species is the balm of Gilead (*P. candicans*), a well-known tree, frequently planted, with large buds noted for their spring fragrance. It is indigenous from Nova Scotia to New Jersey and westward to Minnesota, and is less pyramidal than the type species, usually making a rather broad top. It seems to be disappearing from the woods, though formerly it was a large tree sought for its timber. For the dark tone of its foliage it is often planted as a background tree, but not in smoky localities.

The white poplar or abele (*P. alba*), a European and Asiatic species, which grows about 75 feet tall, has been introduced into America, where it has become naturalized, from Nova Scotia to New Jersey. In Europe it is used for many of the purposes mentioned above. The European aspen (*P. tremula*), common in both Asia and Europe, is known in America mainly by its weeping variety (*P. tremula*, var. *pendula*). The American aspen (*P. tremuloides*) is one of the first trees to appear in clearings, thus acting as an important agent in reforestation, holding the soil until slower-growing trees can obtain a start. (See ASPEN).

About 100 species of insects feed upon the poplars in America. Among these are several species of plant-lice, leaf-miners and leaf-rollers (qq.v.). Among the caterpillars which feed upon the foliage, the most common are probably the larvæ of the antiopa butterfly, the io moth, tussock moth and poplar span-worm; also several general feeders of the families *Noctuidæ* and *Geometridæ*. These creatures may be controlled by spraying, when practical, with arsenites. (See FUNGICIDE). There are also a large number of borers which live in the trunks or twigs. The roots and trunk are attacked by *Prionus laticollis*, which also feed upon pine and apple trees and grape vines.

Consult Sargent, 'Silva of North America'; Packard, 'Insects Injurious to Forest Trees' (Washington 1890).

POPLAR BLUFF, Mo., city, county-seat of Butler County, on the Big Black River, and on the Saint Louis, Iron Mountain and Southern, the Saint Louis and San Francisco and the Butler County railroads, about 125 miles south of Saint Louis. It is in a section where lumbering and the manufacture of lumber products are given much attention. Stock-raising is carried on to a considerable extent. In the vicinity are valuable clay deposits. The chief manufactures are foundry and machine-shop products, cooperage products, brick and lumber products. The city owns and operates the waterworks. Pop. 6,916.

POPLAR SPRING CHURCH (PEEBLES' AND PEGRAM'S FARM, Vaughan Road), Battle of. In co-operation with the movement against Richmond from the north side of James River, 29 Sept. 1864 (see FORT HARRISON, BATTLE OF), General Grant ordered a movement from his left, south of the river, in a northwest direction toward the Boydton road and South Side Railroad, the intention being to extend his intrenched line beyond the Weldon Railroad in the direction of the South Side Railroad. General Warren, with Griffin's and Ayres' divisions of the Fifth corps, was first to secure the junction of the Squirrel Level and Poplar Spring Church roads, coming in from the southwest, at which point the Confederates had intrenchments covering the roads. General Parke, with Willcox's and Potter's divisions of the Ninth corps, was to follow Warren and form on his left, then both were to advance toward the Boydton road. Gregg's cavalry division was to move on the Vaughan road and other roads on the left and rear to the crossing of Hatcher's Run, where the Confederates had a redoubt at the termination of their intrenchments. At 7.30 A.M., 30 September, Griffin and Ayres moved out of their intrenchments at Globe Tavern, advanced cautiously three miles through a dense growth of woods and encountered a Confederate picket-line behind light works thrown up along the road in front of Poplar Spring Church. This line was driven in, and the advance continued, until it came under a sharp fire from a line of works on Peebles' farm, held by Dearing's cavalry brigade and some infantry. A short halt was made, the order to assault was given and the works were carried with small loss. On the left Parke moved through a narrow belt of timber, in a northwest direction toward the Boydton road, and encountered the Confederates on Pegram's farm. The forces holding the Petersburg intrenchments were A. P. Hill's corps and B. R. Johnson's division of infantry, with Wade Hampton's two divisions and Dearing's brigade of cavalry, all under command of A. P. Hill. The main Confederate line of intrenchments had been extended in a southwest direction nearly to Hatcher's Run, covering the Boydton road and South Side Railroad. Hill threw out two divisions, which came into collision with Potter's division, flanked it on the right and drove it back in some confusion. A new line was now formed by Parke, with Willcox's troops, which, with Griffin's line on the right, after a spirited engagement, checked the Confederate advance about dark, after a loss in Parke's command of nearly 500 killed and wounded, and many prisoners. Late in the afternoon next day (1 October) Mott's division of the Second corps came up, and on the 2d Parke advanced, under a heavy fire of artillery and musketry, and established a line of intrenchments about a mile from that of the Confederates, connecting on the right with the line held by the Fifth corps, and on the left reaching the Weldon Railroad and extending to the left and rear. On the left and rear Gregg's cavalry, 30 September, drove back Dunnovant's cavalry brigade, and next day was heavily attacked by Hampton's cavalry on the Vaughan road, but he repulsed the attack, inflicting heavy loss. The Union loss, 30 September, 1 and 2 October, was 187 killed, 900 wounded and 1,802 missing. The Confederate loss is not certainly known, but is estimated at less than 1,000. Consult 'Official Records' (Vol. XLII); Humphreys' 'The Virginian Campaign of 1864-65'; Powell, 'History of the Fifth Army Corps'; 'Battles and Leaders of the Civil War' (New York 1890).

POPLIN, in textile manufacture, a kind of finely woven fabric, made of silk and worsted. In the best poplins the warp is of silk and the weft of worsted, a combination which imparts peculiar softness and elasticity to the material; in the cheaper makes cotton and flax are substituted for silk, which produces a corresponding deterioration in the appearance of the stuff. The manufacture of poplin was introduced into Ireland from France, where it originated, in 1775 by Protestant refugees, and Ireland is still famous for its production. The Irish fabrics having a silk warp and worsted weft and in the common grades cotton or flax is mixed with the silk. The term «poplin» is a corruption of the French *papeline*.

POPOCATEPETL, pō-pō-kä-tā-pĕt'l, a volcanic mountain of the province of Pueblo, Mexico, about 40 miles southeast of the city of Mexico, whence it can be seen as if near at hand because of the clear air of the intervening country. «Smoking Mountain» is the meaning of its name, an Aztec compound, and it is constantly sending out smoke and ashes, and occasionally cinders and stones, but has had only two or three small eruptions in the last four centuries, the last recorded being in 1540. Its height is 17,784 feet, considerably more than that of Mont Blanc, and it was long reckoned the highest mountain in North America. There are oak and pine forests on its sides to a height of 12,540 feet; then a stretch of sand and sulphur before the snowline at 14,960 feet. There are small glaciers on the eastern slope of the mountain. The crater is much smaller than commonly reported, being probably not more than one-fifth of the famed three miles in circumference; its depth, reported as 1,000 feet, seems to be actually only 250. Indians gather sulphur from the rim of the crater. Some of Cortes' men explored the mountain in 1519; three years afterward Montano seems to have reached the top and let himself down into the crater; in 1827 Glennie and Taylor made the ascent.

POPOFTSCHINS. See Religious Sects.

POPOL VUH, pō-pool′ voo, the sacred book of the Quiché (q.v.).

POPPÆA SABINA, pŏ-pē′ạ sạ-bī′nạ, Roman empress, wife of Nero: d. 65 A.D. She was the daughter of Ollius and married Rufius Crispinus, Prætorian prefect, was divorced by him and married to Otho, who in his turn was set aside for the Emperor Nero. She was famous for her beauty, but heartless and immoral. At her desire Nero murdered his mother, Agrippina in 59, divorced and put to death his wife, Octavia in 62, after which they were married. Three years later she was killed by Nero in a fit of rage. The one redeeming incident in her career seems to be the mercy she urged upon Nero in behalf of the Jews.

POPPY, a popular name for several plants of the family *Papaveraceæ;* for instance, California poppy (*Eschscholzia californica*), horned poppy (*Glaucium*), Welsh poppy (*Meconopsis cambrica*), prickly poppy (*Argemone spp.*), celandine poppy (*Stylophorum diphyllum*), tulip poppy (*Hunnemania fumariæfolia*) and various species of genus *Papaver.* Unless modfied by some adjective as above the term usually refers to members of the last-named genus.

The 50 species of *Papaver* are annual and perennial herbs, mostly indigenous to the Mediterranean region. One is South African, one Australian and a few North American. They are smooth or bristly; have a milky juice; usually dissected or lobed leaves on long peduncles; showy flowers of very varied tints and forms, and capsules containing very numerous small seeds. For several centuries some of the species have been leading garden flowers, not only because of their color and form, but because of their ease of cultivation. The seed should be sown very early in the spring where the plants are to remain. Any good, well-drained garden soil will do, but it should be finely broken up and the seed covered very thinly. The seedlings should not stand closer together than six inches for the weak growing kinds and 12 inches for the strong. The removal of the pods as soon as the flowers fade will prolong the blossoming season. If allowed to ripen the seed will stock the garden as weeds. Such plants blossom about two weeks earlier than spring-sown ones. The perennial species should be replaced by new plants each second year, since in cold parts of the country they are likely to winter-kill when old.

The most cultivated species are the opium poppy (see below) and the corn poppy (*P. rhœas*), a European annual with rather small flowers and finely cut foliage.

The Oriental poppy (*P. orientale*), a native of southwestern Asia, is a perennial with large flowers. The Iceland poppy (*P. nudicaule*), an Arctic species, is a remarkably beautiful perennial, which is usually grown as an annual; it is perhaps the best species for cutting as a bouquet flower. Other species are popular with fanciers, but have not gained prominent places in general esteem.

As a garden plant the opium poppy (*P. somniferum*), an annual, is the most famous since it has probably the widest range of color and form. It is, however, noted as the source of poppy-seed oil and opium (q.v.). The seeds, which contain no opium, are rich in a bland, fixed oil (about 40 per cent), which is expressed for culinary uses, and to a small extent for painting and soap-making. The growing of the plants for this purpose has been an important industry in the Old World for centuries. In mild climates the land is made very fine by plowing and harrowing in the autumn when the seed is sown; in colder regions the seed is either scattered on the snow or sown in early spring, the land being prepared previously. Drilling and broadcasting are both popular. Shelter from wind is advisable to prevent scattering of the seed.

POPULAR SOVEREIGNTY. See Squatter Sovereignty.

POPULAR VOTE. See Aliens; Electoral Qualifications; Woman Suffrage; Elections; Naturalization; Vote.

POPULATION, Growth of World Population from 1800 to 1919. One of the most striking facts which we encounter in searching for the causes of the wonderful growth of world commerce in the past century is the discovery that world population has doubled within that period. In all the untold centuries in which man had existed on the globe, the number of people in the world in 1830 was but 850,000,000; to-day the world total is 1,700,000,000, or double that at the time when the application of steam to transportation enabled population to expand into hitherto unpopulated areas and supplied the means by which the products of those areas could be transferred to the continents where population exceeded the food-producing power.

World Population Doubled in 100 Years.— We may fairly fix the date of the practical application of steam to transportation at the year 1830. Fulton had shown the use of the steamboat on rivers as early as 1807, and the little American steamer *Savannah* made the first steam voyage across the Atlantic in 1819, but it was not until 1838 that steam transportation across the ocean was regularly established. Steam engines had moved wagons on lines of rail as early as 1804 but it was not until 1825 that the first railway for the regular transportation of freights, the Stockton and Darlington Railway in England was put into practical operation. The world's railways in existence in the year 1830 were but 200 miles; the world's steamships but 100,000 tons and none of those crossing the ocean.

So we shall do no violence to history if we fix the year of the practical application of steam to freight movement on land and sea at about the year 1830, in which the world's population was 850,000,000 or just one-half of that to-day. The total world population in 1919 is set down by the best authorities at approximately 1,700,000,000 and most of this totalization is by actual count, for countries representing more than two-thirds of the people of the world now take periodical censuses of their respective populations. See the following table:

THE POPULATION OF THE EARTH BY CONTINENTS.

CONTINENTAL DIVISIONS	Area in sq. miles	Inhabitants (number)	Per sq. mile
Africa	11,622,619	142,751,000	12.3
America, North	8,589,257	144,084,000	16.4
America, South	7,570,015	60,854,000	8.1
Asia	17,206,000	872,522,000	50.7
Australasia	3,312,613	16,229,000	4.9
Europe	3,872,561	464,681,000	120
Polar Regions	5,081,935	....	....
Total	57,255,000	1,701,321,000	29.7

The above estimates of areas of North and South America, Europe and Australasia, and of populations are compiled from the 'Statistical Abstract of the United States' and 'The Statesman's Year-book'; the estimates of areas of Asia and Africa are based on planimetric measurements of shore lines; the estimate of polar areas is necessarily an approximation, founded on known data.

The latest estimate of the earth's fertile region in square miles is 29,000,000; steppe, 14,000,000; desert, 4,861,000; polar, 6,970,000.

The population of the earth according to race is based on an estimate by John Bartholomew, F.R.G.S., Edinburgh, revised to 1910:

RACE	Location	Number
Indo-Germanic or Aryan (White)	Europe, Persia, etc.	796,000,000
Mongolian and Turanian (yellow or brown)	Greater part of Asia	630,000,000
Semitic or Hamitic (white)	North Africa and Arabia	70,000,000
Negro and Bantu (black)	Central Africa	134,000,000
Malay and Polynesian (brown)	Australasia and Polynesia	35,000,000
American Indian (red)	North and South America	27,000,000
Total	....	1,692,000,000

Chief Causes of Growth in Last Century.—What are the causes of this wonderful growth in world population in the past century, the addition in less than 100 years of as many as had been accumulated in all the centuries preceding? While there are many causes the most important is that implied by the fact already mentioned that this growth is coincidental with the development of steam power for transportation on land and ocean. Before the advent of steam transportation, man was entirely dependent upon his immediately surrounding area for food, manufacturing materials and manufactures. When the population of a city or community became greater than the food producing power of the surrounding area, the people went hungry, diseases developed and life was shortened. When bad crop years came, there was suffering and starvation, and epidemics swept off population by millions. Life was short, infant mortality high, epidemics frequent, emigration from the congested districts difficult, immigration into the unpopulated areas equally difficult. The walled cities of Europe and Asia with their insanitary conditions and underfed population were popularly designated «man destroyers,» and yet men still thought it necessary to congregate in walled cities or towns for mutual protection, and even those engaged in agriculture lived in little villages, going out to their fields in the morning and returning to their unsanitary homes at night. Of the 850,000,000 people on the globe in 1830, approximately 700,000,000 existed on the single continent of Eurasia (which we now subdivide into «Europe» and «Asia») while the remainder of the world, Africa, North America, South America, Australia and all the islands of the seas had but about 150,000,000, though it should be added that population figures at that date are necessarily based in a considerable degree on estimates of the best experts upon this subject.

Opening New Areas to World Population. — But the application of steam power to transportation on land and sea changed all this. Great areas, especially in the interior of the Americas, which had remained unpopulated because there was no way of moving their possible products to the markets of the more densely populated continent, have developed population and production as the railways were projected into the interior and steamships built to carry their products across the oceans. The population of the United States prior to the advent of the railway was chiefly along the ocean frontage or the navigable rivers. Turnpikes were constructed to enable the areas within a dozen or 20 miles of the river or ocean to move their products to the water's edge, but the great bulk of the fertile interior was too distant from the rivers or ocean to enable its scattering population to send their crops to world markets to purchase the manufactures of other countries. As a consequence the United States only added 6,000,000 to its population in the first quarter of the 19th century, a period in which it had no railways. In the next 25 years, about 9,000 miles of railway were constructed and the additions to the population were 12,000,000, or twice as great as the preceding quarter century in which there were no railways to stimulate the development of the interior. In the third quarter century the new railway construction was 63,000 miles and the addition to the population 21,000,000, or three and one-half times as much as in the like period before the advent of the railway. In the fourth quarter of the century the railway construction was 115,000 miles and the additions to population 32,000,000, or five times as much as in the quarter century when there was no railroads on the land or steamships on the ocean. In the 19 years of the present century, railway construction has been about 75,000 miles and the additions to the population 28,000,000.

Increase of Population and Commerce Coincidental with Railway Development.— The population of the entire United States when railway building began in 1830 averaged only seven persons per square mile; to-day it is 36 per square mile. The population of the Mississippi Valley when railway building began was but 3,500,000 and to-day is 52,000,000, or 15 times as many as when that valley had no railways to connect it with the oceans and no steamships to carry the products to other parts of the world. During this period in which railway construction has developed, 30,000,000 people came from other parts of the world to the United States seeking homes, chiefly in the interior of the country, and with their aid and that of the native-born Americans, the commerce was built up from a little over $100,000,000 in 1830 to $4,250,000,000 in the year preceding the great European War which by its special demand upon our facilities coupled with increasing demand from other parts of the world brought the grand total of approximately $10,000,000,000 in the fiscal year 1919. Our international trade in the year which preceded the European War was 30 times as much as at the beginning of railway construction in the United States, and in the closing year of the war 65 times as much as in 1830 when the United States had but 23 miles of railway.

In the other parts of the American continent, the increased facilities of transportation on land and sea have been followed by a marked growth of population and commerce. The combined population of all America which was but 20,000,000, a century ago is in 1919 fully 200,000,000, and their international commerce which was then $200,000,000 is now $15,000,000,000, or 75 times as much as a century ago when there were no railways to carry the products to the water's edge or steamships to move them across the ocean.

Growth of Population in the Various Sections of the World.— Population has shown dependency upon transportation in all the grand divisions of the world. Europe, with a shortage of food and an increasing power to produce manufactures, has, since the advent of steam transportation, drawn upon the other parts of the world for food and raw material, and to pay for them in the products of her factories, and the other parts of the world with surplus stocks of food and a shortage of manufactures have desired to make the exchanges which Europe wanted, and with these exchanges Europe has been able to greatly increase her already dense population, by drawing food from abroad and paying for it with the products of her workshops, while the Americas, Africa and Australasia have increased their population and natural products and thus greatly enlarged their commerce. The population of Europe a century ago was but 200,000,000; it is now 465,000,000. Asia had at that date about 400,000,000; now it is 870,000,000. Africa's population at that time was possibly 100,000,000; to-day it is 140,000,000, while that of all America has, as already indicated, grown from 20,000,000 in 1830 to 205,000,000 at the present time.

Transportation Facilities, Distribution of Industries and Specializaton of Production.— Steam transportation has thus enabled the newer countries to develop population by giving them access to the vast interior areas having large producing power, while it has also increased the population of the more densely populated countries of the globe by giving to them an opportunity to bring food from other continents at such small cost of transportation that they could pay for it with products from their factories and at the same time still further increase their dense population, the improved conditions of living and better sanitary methods giving to their people greater comfort, better health and a longer span of life than when they were dependent upon the immediately surrounding areas for their daily requirements. The ability of the inhabitant of the densely populated country to obtain his food from the areas which can more readily produce it is illustrated by a recent statement by a very high authority that *a workman in England can now with one day's wages pay the cost of transporting a year's supply of bread and meat from the Mississippi Valley to his own door.* The farmers of the Mississippi Valley can produce food more cheaply than those of Europe and they willingly take in exchange the manufactures with which the dense population of that continent desires to purchase its foodstuffs and raw material.

The Span of Life Lengthened by Medical Science.—It must not be supposed however that the increase of transporting power has been the only cause of the marvelous increase in population which has characterized the past century. Medical science and hygiene have greatly decreased infant mortality and increased the span of life for those reaching maturity. No exact figures can be given by which to compare these conditions of the present time with those of a century ago, but it is an accepted fact that the «expectation of life» for the average human being is now much greater than formerly. And this has been a factor of considerable importance in the growth of world population.

Use of Machinery in Food Production.— Another factor is the ease with which food may now be produced through the use of machinery, which has thus reduced the amount of human labor and time required to produce a given quantity of the requirements of man. The United States Department of Agriculture states that the amount of human labor now required to produce one bushel of wheat is but 10 minutes against 133 minutes in 1830. This marvelous change is the result of the application of machinery to the preparation of the land, the planting of the seeds and the harvesting and threshing of crops, while the labor required to turn it into form for food has also been greatly decreased. The great slaughtering houses which now turn cattle and swine into fit form for food receive an endless procession of living animals at one entrance and with a few minutes of labor turn out the finished product at the exit, sending the fresh meats by refrigerator cars and vessels to the markets on the opposite side of the globe and at the same time so conserving the by-products that the waste which accompanied the crude methods of former years no longer exists.

New Foods Increase the Power to Sustain Population.—Another reason for the increase in power of the world to supply the requirements of man is found in the acceptance of new varieties of food which the increased facilities of transportation can now bring from other parts of the world or introduce for adaptation to the soils of countries in which they did not formerly exist. We of the United States, for example, are now bringing into this country over $100,000,000 worth per annum of food oils or the material from which they may be produced as against $15,000,000 a decade ago, and this use by us of the untold quantities of a highly valuable food formerly going to waste in all parts of the tropics is also occurring in ✓

other parts of the world, especially the densely populated countries of Europe, which are rapidly increasing the use of vegetable fats from the tropics. Sugar, an extremely valuable article of food, has developed with astonishing rapidity as a result of cheap transportation and better process of manufacturing, and the world's production of sugar in the year preceding the war was 40,000,000,000 pounds against 4,000,000,000 pounds a half century earlier. The world's corn crop of which the United States is the world's largest producer is now about five times as much as 50 years ago. Meantime we have brought from other parts of the world many grain and other food products and so adapted them to our own soils and climate as to materially increase our power of sustaining a large population.

Increased Density of Population no Longer Considered Alarming.— Even those sections of the world long looked upon as densely populated go calmly on increasing their populations at a rapid rate and producing the bulk of their own food by the exertions of their own people. Japan, for example, one of the most densely populated countries of the Orient, has doubled its population in less than 50 years, yet it imports comparatively very little foodstuffs, drawing its chief food supply from its rice fields with which the mountain sides are terraced and the surrounding seas whose fisheries supply practically all of the animal food consumed by the people of Japan. These require the time of about 2,000,000 people in accumulating and preparing the nearly $100,000,000 of sea food which that industrious people draw from the surrounding waters. Java, the most densely populated island of the world, has doubled its population in less than a half century, and its people, who now average more than 700 per square mile for the entire island, draw most of their food from the rice fields and the fishing industry, and have rendered the island extremely prosperous with such valuable products as coffee, tea, sugar, spices, cinchona, tin, petroleum and India rubber, which they exchange with other parts of the world for such requirements as they are not able to meet from their own sources of production. Germany, with an area less than our State of Texas, had doubled its population between 1840 and 1914, and with a population 10 times as dense as our own was, before it entered upon the great war, looked upon as one of the most prosperous countries of the world, drawing much of its food and manufacturing material from other sections of the globe and paying therefor with the product of the manufacturing industries. England, with a population much more dense than that of Germany and equally dependent upon other countries for food and manufacturing material, doubled her population in the past 60 years and ranks among the most prosperous of the world's nations, bringing its food and manufacturing materials from long distances and paying for them with the products of her work shops.

Relative Density of Population in Representative Countries.—We of the United States can scarcely realize how much greater is the density of population in certain other countries than that of our own. We have in continental United States, exclusive of Alaska, an average of 36 persons per square mile, while Germany has 325 per square mile, Italy 332, Japan 392, Netherlands 499 and England an average of 624 per square mile, or 17 times as much as our own. *If all the people of the entire world were set down in continental United States, exclusive of Alaska, our average density of population per square mile would be less than that of England to-day.* Yet England is looked upon as one of the most prosperous countries of the world and feeds her dense population in large part with food brought from other countries, often from the opposite side of the globe, and paying for the same with the product of her factories.

The Drift to Industrial Centres.—With this change in the habits of life among the people of the world, the exchange of food of the agricultural areas for the manufactures of other areas, the density of population in the manufacturing areas has gone on increasing without the danger of starvation or food shortage which existed a century ago when cheap transportation of food across the ocean was impossible. In England, for example, the share of the population living in cities of 10,000 or more was in 1800 but 21 per cent and 66 per cent in 1900. The British census of 1851 classed 49 per cent of the population as «rural» and in 1911 only 22 per cent was classed as «rural.» The population of the 12 great cities of England was in 1820 2,000,000 and in 1919 is 9,000,000. In Scotland in 1800 only 17 per cent of the people lived in cities of 10,000 or upward; now it is over 50 per cent. In Prussia in 1800 only 7 per cent of the people lived in cities of 10,000 or more; in 1890 it was 30 per cent and at the beginning of the war approximately 40 per cent. These changes are the result of a transfer of labor in the older countries from agriculture to manufacturing and reliance upon younger countries for food and manufacturing material.

This habit of accumulation of population in dense masses and of drawing food from other areas better able to produce material of this character is exemplified in a striking degree in the United States which has recently become a great manufacturing country. The share of our own population living in cities of more than 10,000 was in 1800 only 4 per cent; in 1890 it was 28 per cent, while the share of the population living in cities of 2,500 or more in 1910 was 46 per cent and at the present time is approximately 50 per cent. Thus it may be said that even in this comparatively new country, with its large agricultural powers, approximately one-half of our population now live in cities or towns and draw their food and manufacturing material from other areas, some of them on the other side of the globe. While the United States is still the world's greatest producer of both food and manufacturing material, it now brings from other countries, mostly across the ocean, about $2,500,000,000 worth of food and manufacturing material annually, and these two groups of material actually form 85 per cent of the merchandise imported into this country, much of it traveling half-way round the world before entering our ports. Great Britain is another example of the reliance upon other parts of the world for food, since with a population less than half our own she brings in normal years nearly $3,000,000,000 worth of merchandise, chiefly food and manufacturing material from other countries, much of it across the ocean.

Will the Recent Growth of Population Continue?— Now a word as to the future. The population of the world has doubled in the past century. Will it double again in the next 100 years? Probably not. The rate of growth has perceptibly slowed down in the past quarter century and is now at the rate which suggests a net increase of little more than 1,000,000,000 in world population during the next century, giving a grand total of about 3,000,000,000 as the world's entire population a century hence.

Can the world sustain a population of 3,000,000,000 as against 1,700,000,000 at the present time? Undoubtedly. The developments of science and industry will bring under the control of man vast areas now contributing practically nothing to his support. The great tropical and subtropical belt which stretches round the world between the 30th parallels of north and south latitude has about one-half of the land area of the globe, but now supplies but one-sixth of the products entering international commerce, despite the fact that its producing power per acre or square mile is double or treble that of the like area in the temperate zone. With the lessons of the war, man has learned to substitute the internal combustion engine for the horse which could not perform a satisfactory service in the tropics, and with this new instrument of production and transportation he will now, after long years of waiting, be able to conquer the tropics and multiply the production of the food and manufacturing materials which they can so easily turn out and for which the other sections of the world are clamoring. The producing power of the older and longer cultivated lands of the world is largely dependent upon the soil foods supplied, and with the lessons of the war, man has learned to reach out into the air and obtain unlimited quantities of that most important of soil foods, nitrate, utilizing for that work the power of the waterfalls which has been going to waste in the past. The great deserts of the world now producing nothing have shown that they only need the application of water to render them more productive per acre or square mile than those of the areas now under cultivation, and man is gradually learning methods of bringing to them the necessary moisture from beneath the surface or from distant water courses, and at the same time has learned through the application of "dry farming" to obtain enormous quantities of food from areas formerly considered of little value as food producers. The substitution of the internal combustion engine, utilizing gasoline, kerosene, heavy oils or alcohol, will take the place of the horse and thus release enormous areas of land hitherto devoted to producing food for that animal whose services will be no longer required. The scientists of the world are showing us every day the feasibility of utilizing for food purposes untold quantities of natural products which have been permitted to go to waste in the past, while the world is also gradually coming to understand the importance of so conserving the products of nature as to render them far more valuable in the future than under the wasteful methods of the past.

Division of Labor and Specialization of Industry.— All of these things, the disposition of the densely populated countries to continue their growth of population by drawing foods from abroad and increasing their output of manufactures to pay therefor, and the disposition of the agricultural countries to continue their growth by increasing their output and accepting manufactures in exchange, means the application to world industries of that great economic law "The Division of Labor and Specialization of Industry." Man long ago learned that this system would give better results in the operations of considerable groups of people under a single management. The manager of the successful factory divides the various processes required for producing the completed article among a large number of people or groups, but keeps each man or group of men steadily at the particular part of the work in which he has thus become especially expert. By this process of distributing the various parts of the proposed article to small groups of individuals and keeping each group continuously employed upon that particular part of the work, he increases the producing power of the factory and cheapens the cost of producing the articles being manufactured.

This system, of a division of labor and specialization of production, so successful in the operations of comparatively small groups of men, is now being applied, perhaps unconsciously, to the production of the world, through the co-operation of cheap and plentiful transportation. Europe, the United States and Japan have become the world's great manufacturers and the agricultural, forestal and mineral areas in other sections of the globe have become the producers of food and manufacturing materials. As a result of the distribution of labor and specialization of production in the great world industries, the quantity of the respective articles which each group of men can produce has been greatly enlarged and the cost of production, measured by man power, correspondingly reduced, while cheapened transportation developed by another group of specially trained men enables the interchange of these articles at small cost.

As these great principles of division of labor and specialization of industry are applied from day to day to the world production of the staples required by man, they are being, little by little, extended to such new articles or industries as may be developed by the ingenuity of the human mind. The producing powers of the whole world are thus steadily increased, while the amount of man power required for the production and distribution of the respective products is being decreased by the same process of specialization.

As a result of these conditions, the division of labor, the specialization of production and the cheapening of transportation, the world today is able to sustain a population double that of a century ago, with greater comfort, greater prosperity and a higher degree of intelligence than at that time. When we consider what has been done in this line in the last century, we may confidently expect that the world will be able to meet the requirements of such further additions to its population as the future may bring.

POPULATION OF THE WORLD 1800 TO 1919.

Based upon official returns and estimates by accepted authorities.

(In millions)

	Total population	Europe	America	Asia	Africa	Australasia
1800.	630	175	10	365	75	5
1820.	760	208	20	430	95	6
1840.	950	238	45	560	100	7
1860.	1,205	295	90	690	110	8
1880.	1,430	350	140	780	120	10
1900.	1,550	410	170	817	130	13
1919.	1,701	465	205	873	142	15

O. P. AUSTIN,
Statistician, National City Bank of New York.

POPULATION, Relation to Wealth to. See CAPITAL.

POPULIST PARTY, The. See PEOPLE'S PARTY, THE.

PORBANDAR, pōr-bŭn'dar, India, a seaport town, capital of a native state of the same name, in the political agency of Kathiaway, Bombay. It is built on a creek on the southwest coast of Gujerat and has an active shipping trade with Bombay and Malabar. Pop. 19,000. The state has an area of 636 square miles and a population of 85,785.

PORBEAGLE, a shark of the family *Lamnidæ,* more usually called mackerel sharks (q.v.), on the northeastern American coast. The best-known species is *Lamna cornutica,* the Beaumoris shark, which occurs in the north Atlantic, attains a length of 10 feet and feeds chiefly on fishes. The porbeagle has two dorsal fins, a wide mouth, lanceolate teeth and very wide gill openings.

PORCELAIN. An argillaceous substance characterized by its translucency and vitrification; hence the ware made from the same is often so termed. These two qualities are not found combined in other pottery, earthenware being porous and opaque and stoneware being vitreous but not translucent. The derivation of the word is not clear, but some claim it comes from the cowry shell named *porcellana* (Italian) or *porcelana* (Spanish), part of the enamel coating of which has the appearance of porcelain.

Technology.— The body or substance of which porcelain is made is termed *paste* or *pâte* (French). The Chinese hard-paste porcelain (first to become known to Western civilization) is made up of certain proportions of clays known as *kaolin* and *petuntse* or cornish stone. Kaolin is frequently called *china clay* and *cornish clay* on account of its most prolific source of high quality being Cornwall (also Devon), England. Both kaolin and cornish stone are the natural products of weathered granite (*pegmatite*). Kaolin is a silicate or alumina and infusible, while cornish stone (*petuntse*), a feldspar containing silicate of alumina combined with potash, soda and lime or barium, is fusible and acts in the furnace to produce with the kaolin a molten mass of homogeneous texture and having conchoidal fracture like glass. Porcelain is generally divided into two main classes known as *hard-paste* and *soft-paste* or *natural* and *artificial.* The French know them as *pâte dure* and *pâte tendre,* terms very frequently used by English-speaking connoisseurs. In general it may be said that the hard-paste is not scratched with a file or steel point while soft-paste is abraded under such a test. Soft-paste is slightly porous. While hard-paste porcelain is, as before stated, produced (body and glaze) from koalin and china stone, soft-paste was made (the Chinese clays being unknown at first) in imitation of the Eastern wares from substitutes after an enormous amount of research. But the old Sèvres soft-paste was an artificial body and glaze of astonishing beauty and perfection, its unctuous, soft tone contrasting much in its favor on comparison with the glaring whiteness of the Chinese natural porcelain body. Brongniard, the great ceramist and director at the Sèvres works (middle 18th century), gives the following formula as a favorite at the royal factory: molten nitre, 0.220; gray sea salt, 0.072; alum, 0.036; Alicant soda, 0.036; Montmartre gypsum, 0.036; Fontainebleau sand, 0.600; all made into a frit (fused into a vitrified mass, then pulverized). This glassy substance was mixed with the following ingredients, in the following proportions, to produce the actual *pâte:* Frit (as above) 0.75; calcareous marl from Argenteuil, washed, 0.068. A glaze formula was: calcined Fontainebleau sand, 0.27; calcined flint, 0.11; litharge, 0.38; carbonate of soda, 0.09; carbonate of potash, 0.15. The physical softness of this *pâte* and glaze allowed the colors in the decoration to sink into *pâte* and glaze so as to leave a lovely mellowness like wax. In 1769 Sèvres started hard-paste. One considerable advantage which soft-paste has over hard-paste from the manufacturing point of view is the fact that less heat is required in the baking; but, hard-paste firing at from 2,462° F. to 2,642° F. with safety, while soft-paste permits only a margin of heat of from 2,012° F. to 2,102° F. gives hard-paste a safety margin against crazing of 180° F. against a range of but 90° F. for soft-paste firing. The firing, which is done in specially constructed ovens, takes place after the wares are stacked in safety, protected by fire-clay covers, known as *saggers.* The incandescent heat of the hard-paste furnace is generally called by experts by the French term *grand feu,* sometimes *hard fire,* while the lesser heat required in baking the body of other wares is termed *demi grand feu.* The preparation of the clays for porcelain is done in blungers, sifting machines, etc.; the forming or shaping of the mass or body on the potters' mold or in the modern turning lathes, «jiggers,» «jollies,» all of which processes common to all classes of pottery, do not belong under this specialized head (see CERAMICS; CLAY; POTTERY, and related references).

Colors.—The only colors that will stand the *grand feu* heats of hard porcelain are: blue from cobalt, red from copper and *céladon* green and brown from iron. These, therefore, are used *under* the glaze. In order to extend the range of colors on hard porcelain ware a separate firing becomes necessary, either in an oven of less heat or exposed in parts of the incandescent oven which are not reached by the most intense temperature. Of such are turquoise blue from copper; purple from manganese; yellow from iron with a proportion of antimony. Colors which will stand in kilns of lesser heat are red, from iron oxide; brown, from iron chromate or manganese; green from copper; yellow from antimony; rose and purple from gold.

History.— No industry furnishes a history so full of romance as that of porcelain. The discovery of the porcelain body was made in China; the first production having the characteristics of translucence with vitrification would appear to have taken place at the end of the 6th century. The cause of its discovery is the great love and reverence of the Celestial for jadestone. Carved jade was, par excellence, the most valued of the Chinaman's possessions, and it was in the attempt to obtain a substance with the qualifications of this hard, semi-translucent, greenish-yellow mineral (*nephrite*) that kaolin was used for a body or mass, combined with other silicious material, and *céladon* was the outcome from which magnificent vases, bowls, etc., were produced. Céladon could not be called translucent. By the 7th century, at least, we know that at Changnanchin, called later Ching-tê-chên, true porcelain was in course of manufacture in large quantities having the qualities of being translucid, stone-hard, resonant and of vitreous fracture — the natives called it *Tzû* to distinguish it from *Wa*, earthenware. A description of the different lovely wares of the Chinese dynasties will be found elsewhere (see CHINESE CERAMICS). Already in the 16th century Chinese porcelain ware was becoming known in different parts of Europe as rare and lovely works of art of great value and Florence (under the Medici) attempted to make imitations, at the end of that century, of Chinese specimens in their possession. It was an artificial glassy porcelain made from impure china-clay (Terra-Vicenza), fine white sand and powdered glass. With the growing admiration of Europeans for the Oriental porcelains and the increasing numbers of superb collections among the royalty and nobility grew up an intense desire to produce the ware at home. The Jesuit priest, Père d'Entrecolles, during his prolonged stay in China gathered a mass of information as to the methods of manufacture of the coveted ware and sent detailed accounts home of his discoveries among the kilns of Ching-tê-chên from 1712 to 1722. They did not bring about the discovery of materials for the porcelain body, however, though they assisted greatly in giving invaluable information on the Chinese methods of porcelain decoration. To meet the popular clamor for pieces of pottery similar to the Oriental porcelains at a cost within the reach of the bourgeoisie of wealth the lovely specimens of *blue-and-white* underglaze and some polychrome pieces (see CHINESE CERAMICS) were reproduced in earthenware coated with a tin-glaze opaque white slip by the 17th-century Dutch potters at Delft. (See DELFT). In spite of diligent search, the clays which produce porcelain remain unknown. The Japanese nation claims that its knowledge of art pottery was gained from the Koreans, but Chinese influence introduced porcelain manufacture to the realm of the Mikado. With the Japanese connoisseurs porcelain took a secondary appreciation and earthenware alone received their patronage. The peculiar decorative talents of these islanders produced clever porcelain styles that quickly attracted European attention and demand and the trading companies of Holland and England were soon importing great quantities of Japanese alongside the Chinese wares. The porcelains of Japan are described fully elsewhere. See JAPANESE CERAMICS.

European Porcelains.— While both Florence and Venice had produced pieces of art ware of porcelain appearance, these were but of glass body with admixture (perhaps) of ground Chinese porcelain fragments. Of recent years the honor of making porcelain ware in industrial quantity has been awarded to Rouen, where a good quality of ware was produced in an admirable soft porcelain body. In 1673 Edme Poterat (talented faience master) secured a license to manufacture in his earthenware works porcelain as well as faience. It was carried on till 1696 by Louis Poterat, a son, who when he died had never divulged the secret working formula. Several pieces of this rare ware are in Europe and America (Morgan collection). Pierre Chicaneau's porcelain factory at Saint Cloud was active as early as 1670 and the letters of several contemporary notables testify to the fact that both in painted decoration and beauty of form and finish the ware fully equaled that of the Chinese. It continued in operation till 1766. A number of pieces are found in present-day collections proving the high quality of this ware, which, besides cups and saucers, includes tea-pots, milk jugs, candlesticks, spice-boxes, handles for knives and forks. The delicate relief work is remarkable, but the pieces are rather thick. Johann Friedrich Böttger, a German alchemist, was the first to make hard porcelain in Europe. His claims of power to turn base metal into gold caused Augustus II, Elector of Saxony, to hold him in captivity in preference to turning him over to the king of Prussia, who was anxious for him to carry out his proclaimed powers in Berlin. Böttger, under the protection of the Elector, set up his furnace and laboratory in Dresden. But his failure to bring forth the precious metal caused him to be moved from place to place as a prisoner under associates of the king. After several attempts at escape his life was in danger from anger at his deceptions till he discovered the process of making a red stoneware of extreme hardness which stood polishing on the lathe, much to the pleasure of the king, and by 1707 he was producing much of the ware for the courts. In 1709 Böttger discovered kaolin in his neighborhood (a barber is said to have been using the white powder on his wigs and told him whence the mineral was derived). His success was so quick that large quarters for the making of his true porcelain ware became necessary and he was transferred to Albrechtsburg Castle at Meissen. He died in 1719, but the factory and its ware became the most noted in Europe. The progress of the Meissen styles is one of extreme interest and is fully described elsewhere (see DRESDEN PORCELAIN). Of equal note with the beautiful productions from Meissen, Germany, are those lovely creations in *soft* porcelain made at Sèvres, France. Established first at Vincennes, in 1738, this factory, which had come into possession of the king, was transferred to Sèvres. As already described, the development of the Sèvres *pâte* was a fine art carried out with the most exhaustive research. The Sèvres body transcended in delicate beauty and softness anything produced at Meissen and we are indebted to the fact that kaolin had not been discovered in that section that we inherit an artificial porcelain body that is the admiration of the world. The wealth of royalty caused marvelous pieces in the most delicate color decoration to be made for the court and for gifts to foreign rulers, regardless of the great expense in production. A full account of the history and products of this world-renowned porcelain will be found under another title (see SÈVRES). Already in 1725 Ciquaire Cirou had established a porcelain factory at Chantilly under the patronage of Louis-Henri de Bourbon, Prince de Condé. Beautiful figures, but mainly table services, artistically decorated, were its chief products. Japanese decoration frequently is found on earliest pieces, for the factory license was granted to produce pieces in imitation of the Japanese porcelains. For Japanese porcelains were becoming vogue with their clever *kakiemon* decorative methods. Chantilly factory remained active till 1800. And from now on many members of royalty and nobility aided in the starting of porcelain factories in different parts of France, even when the laws protecting the royal Sèvres monopoly forbade the competition. Soft porcelain was made at Mennecy-Villeroy from 1734 till 1773 when the factory was transferred to Bourg-la-Reine, continuing till 1806. Others opened as follows: Lille (1711), Sceaux (1749), Orleans (1753), Crepy-en-Valois (1762), Saint Amand-les-Eaux (1771), etc. But about 1768 kaolin was discovered at Saint Yrieix (Haute-Vienne) and France turned to making *hard* porcelain at Orleans (from 1768); Brancas-Lauragais (1764), where kaolin and petuntse were also found as early as 1750; Vincennes (from 1765), Niderviller (1765), Vaux (1769), Lunéville (1769), Arras (1770). At Paris alone we find the following hard porcelain factories established: Rue de Bondy, named after the Duc d'Angoulême (1780); Faubourg Saint Antoine (about 1773); factory of the Comte d'Artois (about 1769); Clignancourt (1771); La Courtille or Basse Courtille, in the faubourg du Temple (1771); «Prince des Galles» factory, rue de Cressol; Duke of Orleans' factory in Faubourg Saint Antoine (about 1784), then transferred to Pont-aux-Choux; rue Popincourt factory (1782); rue de Reuilly (1774); rue de la Roquette (1774); rue Thiroux (1775), made «Porcelaine à la Reine.» Other notable hard porcelain factories were established as follows: Arras (1770), La Seynie (1774), Marseilles (1776), Boissette (1778), Lille (1784), Valenciennes (1785), Caen (1797). In Belgium a factory was started in 1750 at Tournay which became one of the most flourishing in Europe, lasting to the present day. In Germany very noted factories, besides that of Meissen (Dresden) and turning out the most beautiful art ware (figures, etc.), must be mentioned that of Fürstenberg, established in 1746 by Duke Karl of Brunswick with Johann Christoph Gläser of Bayreuth as expert. Its activities continue to this day. At Höchst (1746) porcelains were produced that brought the factory to be third in Germany after Meissen and Berlin, but the works were closed in 1798. In 1750 Wilhelm Caspar Wegeli established a factory at Berlin, but he closed to take up the wool industry in 1757. The sculptor, Ernest Heinrich Reichhard, got possession but turned over the place to J. E. Gotzkowski in 1761. Friedrich Elias Meyer, the modeler, was engaged with Jaques Clauce, the noted enamel painter and other skilful craftsmen. Lacking success Gotzkowski sold the factory (1763) with a rich stock, 133 figure molds and other valuable material for 225,000 thalers and the place received the title «Königliche Porzellan-Manufactur» as the property of Frederick the Great, who got craftsmen from Meissen and soon established successful operations. The early yellowish-gray paste formerly used was displaced by that made from kaolin obtained in Silesia, making a whiter paste. Rococo style was in highest vogue so Berlin pieces of the early period are steeped in the extravagances of this style. Grand pieces were constructed for the king's court, candelabra and mirror-frames for Sans-Souci Palace, a great centre table-piece for Catherine II of Russia consisting of allegorical and other figures in white biscuit (unglazed). Biscuit has been ever since the usual method of production of Berlin figures. Coffee and tea services from this factory show very delicate decoration *en camaïeu*. Berlin's iron-red and rose-crimson are two of her best successes in colors. The factory is still active but has suffered from the same degeneracy in art as other fabriques. The porcelain factories of Frankenthal (1755) and Ludwigsburg (1758) are noted for the lovely art works produced, but lack of space forbids their detail; the same must be said of the factory at Nymphenburg (1758), bare enumeration of their existence being here alone possible together with the statement that their productions when they appear in the auction-room bring extraordinary prices and are considered worthy the cost. Cassel (1766) and Kelsterbach (1758) and Fulda (1765), all had porcelain factories, and in the Thuringian forests, where kaolin was discovered and fuel was cheap, Sitzendorf-Volkstedt (1762), Gera-Unterhaus (same date), Kloster Veilsdorf (1765), have their works still active. Wallendorf (1765), Gotha (1767), Limbach (1772), Grossbreitenbach (1780), Rauenstein (1783), Tettau (1794) and Possneck (1800) are all in more or less successful operation to this day. The porcelain factory at Vienna was established in 1718 but failed to make headway, and to 1744 had been a financial failure all the time. Its sale to the state in that year permitted a more substantial condition to prevail and both demand and supply grew till the great trade depression that started in 1779 caused such an unsatisfactory financial condition at the factory that (1784) it was offered for sale without bidders. Rococo, the prevailing style of decoration of that period, predominates in the Vienna wares of this second period. In the latter-mentioned year the factory was placed under the control of Baron von Sorgenthal as director; and the fortunes of the fabrique rapidly changed for the better and with an ever-increasing demand that made the space cramped and a branch was started in 1799 at Engelhardzell, near Passau. The rococo style gave way to antique classic under Sorgenthal. In 1805 Vienna entered on her fourth period, when Sorgenthal died and Niedermayer took his position and continued the financial success in spite of the severe obstacles created by the war, such as the loss of Passau and the factory at Engelhardzell. By 1816 decline set in and in 1827 Niedermayer retired, the fifth period opening with Benjamin Scholtz directing. He used cheap clay and made poor quality of ware and the factory declined still further till 1833, when Scholtz died and Baumgartner, professor of physics at the university, succeeded. A small profit was now made by producing common porcelain for domestic use. Later more artistic work was undertaken (1856) by Alexander Lowe, but in 1864 the factory was closed to stop the continuous loss. Holland had porcelain factories at Weesp (about 1763), Oude Loosdrecht (about 1774) and The Hague (1778), but none lasted long. Switzerland, in Zürich (1763) and Noyon (end of the 18th century), had porcelain factories but they soon closed. Kaolin was discovered in Denmark (1756) and a porcelain factory was opened the same year in Copenhagen, which after changing hands was followed by a new factory in 1772, but it was no success till, in 1779, the king took up the works and it is still running and producing beautiful art work worth lengthy comment. In Italy, besides Florence and Venice before mentioned early in this article, Doccia (1737) made both soft and hard porcelain; Capo-di-Monte also made soft porcelain of lovely character and refinement from 1742 till 1759, when the king of Naples and Sicily became king of Spain and removed his factory to his palace of Buen-Retiro, near Madrid, where work continued till 1808. At Saint Petersburgh, Russia, about 1745, Empress Elizabeth started a hard-paste factory which has continued to this day. The chief work strongly imitates Meissen (Dresden) during the Seven Years' War period as the workmen were from Meissen; then followed Sèvres style.

English Porcelain.— So far as known the first English soft paste was made at Chelsea (earliest specimen dated 1745). Bow is said to have produced artificial porcelain as early as 1730, but 1740 is generally considered the date of work on a commercial scale. Derby works were started in 1756 and Worcester was established in 1751. Other factories are those of Longton Hall (1752), Davenport (1794), Minton (1798), Spode (after 1797), Lowestoft (1756?), Liverpool (Herculaneum 1800), Caughley (1772), Coalport (after 1814), Pinxton (about 1795), Church Gresley (1795), Nantgarw (about 1813), Swansea (1814). Kaolin and petuntse for making *hard-paste* porcelain were first discovered by Cookworthy (1758) in Cornwall and the first factory to make true porcelain was at Plymouth (1764); he sold out to Champion of the Bristol works (1770). Full description of the history and characteristics of the wares of prominent factories will be found under the titles Bow, BRISTOL, CHELSEA, DERBY, LOWESTOFT, WORCESTER, etc.

With the 18th century certain proportions of bone had been used in the ingredients composing the porcelain body by certain factories; with the beginning of the 19th century this *bone paste* had become standardized in all factories and, as a consequence, the English «standard» or «bone» porcelain swept aside all other kinds and the factories of the Continent found themselves faced with a condition in which the English porcelain factories filled all the common needs of the European table services with a pure white, inexpensive, hard-porcelain, impossible of competition. The «standard» ware has been universally used for commercial ware ever since.

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PORCELAIN CLAY. See KAOLIN.

PORCELAIN TOWER, a tower which was erected in the early part of the 15th century and destroyed by the Taipings in 1853. It was octagonal in construction, had nine stories, faced with variegated porcelain (from which it received its name), and from these lamps and bells were hung. A miniature reproduction of the tower may be seen in the Green Vault in Dresden.

PORCH, a covered place of entrance to a building and differentiated from its principal mass. Its forms are various, sometimes extending above by more than one story, sometimes enclosed save for the doorway, then again open to the outside on three sides, with its outer corners supported by columns or piers. It may be simplified into an overhanging hood or baldachino. In Byzantine and Eastern churches the porch was an enclosed atrium or narthex, a feature that has developed with modifications into the mosque of the Moslems. The enclosed atrium was retained in the early basilican churches and contained a fountain where worshippers might wash their hands,— the origin of the present universal Roman Catholic practice of dipping the fingers in the holy water of the piscina. In this space, probably always called the narthex of the basilica, the penitent or unbaptized persons were compelled to stay. Such a structure may be seen in the church of San Lorenzo, in Rome, and Saint Apollinaire in Clusse at Ravenna. The narthex extended across the front of the church and its inner wall contained three doors that gave upon the nave and aisles of the main body. Of Romanesque churches, the porch of the church of

Vézelay is an important example; while the church of Saint Germain l'Auxerrois in Paris shows a Gothic edifice with a porch extending across the front, dating from 1431, its horizontal crown in sharp contrast to the climbing lines of the main edifice.

Porches are characteristic of the Gothic style in Italy, though instead of being placed in front they often occupy positions on the flanks, thus forming side entrances. A remarkable specimen in three stories, the upper and surmounting one of a pagoda-like structure, is attached to the church of Santa Maria Maggiore at Bergamo.

PORCIA. (1) The plebeian gens of Rome, flourishing from the 3d century B.C. and whose most famous family was that of Cato. (2) An ancient lady living in Rome, the daughter of Cato, of Utica. She became the wife of M. Bibulus, who was Cæsar's colleague in the consulship, in 59 B.C., by whom she had three children, and after his death married M. Brutus in 45 B.C., who later murdered Cæsar. After the death of Brutus she committed suicide.

PORCUPINE, a rodent of the family *Hystricidæ*. Porcupines are distinguished by the peculiar nature of the body-covering, which consists, especially on the back and haunches, of hairs specially modified to form the so-called *quills*, or dense, solid, spine-like structures. These quills are intermixed with bristles and stiff hairs, and in the American subfamily *Synetherinæ* are almost concealed beneath the hairy fur of the body. The incisor or front teeth number two in each jaw and spring from permanent pulps, so that they continue to grow throughout the lifetime of the animal as in the other members of the order. There are four molar teeth on each side of each jaw, exhibiting complicated foldings of the enamel on both the internal and external sides; and sometimes they, like the incisors, continue to grow throughout life from persistent roots. The skull exhibits an infraorbital foramen of very large size. The muzzle is generally short and broad. The lip is divided and the ears short and rounded. The anterior feet possess four and the hinder feet five toes, all provided with strong, thick nails. The tongue is roughened or, as in the Javan porcupine, may be provided with horny plates or scales.

The family *Hystricidæ* is divided into two groups, *Histricina* and *Synetherina*, or two subfamilies, *Hystricinæ* and *Sphingurinæ*. The *Hystricinæ* or Old World true porcupines are terrestrial, and have imperfect clavicles and open rooted molar teeth. They fall into several genera. Of these the most familiar is *Hystrix*, represented by the true porcupines. The common or crested porcupine, *Hystrix cristata*, found in southern Europe and in northern Africa, is the best-known species. The true porcupines have non-prehensile tails, which may be spiny or covered with scales or bristles. When fully grown the common porcupine measures nearly two feet in length, and some of its spines exceed one foot. The general color is a grizzled, dusky black. The upper part of its head and neck is furnished with long, light-colored hairs, capable of being raised or depressed at pleasure; and most parts of the back and sides are armed with spines, which are longest on the centre of the back. In their usual position they lie nearly flat upon the body, with their points directed backward; but when the animal is excited they are capable of being raised. The quills are loosely inserted in the skin, and may, on being violently shaken, become detached — a circumstance which may probably have given rise to the purely fabulous statement that the animal possessed the power of actually ejecting its quills like arrows or darts at an enemy. These animals generally lead a solitary life, and inhabit burrows during the day, coming forth at night in search of food, which consists of vegetable matter. The common species is quiet and peaceable, but shows no disposition to become familiar or domesticated. An Indian form (*H. leucurus*) resembles the crested porcupine, but is larger.

The genus *Atherura*, including three species, possesses a long scaly tail, which is terminated by a tuft of bristles. The species of this genus occur in the Malayan region and West Africa. The *Atherura fasciculata*, or brush-tailed porcupine, is a familiar species of this genus. The *Synetherinæ*, or American tree-porcupines, are easily distinguished by their well-developed clavicles, molars with closed non-growing roots, usually prehensile tails, the feet with tuberculated soles and the absence of the pollex. The three genera are confined to America.

The Canadian porcupine (*Erethizon dorsata*) is the best known, and is a robust animal with a short non-prehensile tail. It is about two and a half feet long; of a brownish color, mingled with white; the spines are about four to six inches long, concealed in the fur and attached in a very slight manner to the skin, and, from being barbed at the tip with numerous small reversed points or prickles, they by degrees penetrate very deeply into the flesh after having once pierced it. Small and insignificant as these defensive weapons may appear, they are capable of severely injuring dogs, wolves or indeed any animal that incautiously attempts to seize the porcupine. These spines or quills were much used among the Indians to ornament different articles of dress; they dyed them various colors, in a very permanent manner. The Canada porcupine is found in the thickly wooded parts of northeastern United States and in Canada, the northernmost limit of its distribution being the shores of the Mackenzie River and the southernmost the high mountains of Pennsylvania. They feed on the barks of various trees, apples, corn, etc. Their flesh is said to be very unpalatable, resembling flabby pork. They pair about the latter end of September and the female brings forth two young in April or May.

The genus *Synetheres* of South America to Mexico possesses a distinctive feature in the elongated prehensile tail, adapting it for an arboreal existence. They are the true tree porcupines. About 10 species of these animals are indigenous to America, the spines, as in the Canadian porcupine, being of much smaller size than in the Old World forms. In length the typical species of this genus averages one and one-half feet, the tail measuring about 10 inches.

Consult Stone and Cram, 'American Mammals' (New York 1902); Merriam, 'Adirondack Mammals' (New York 1884).

PORCUPINE ANT-EATER. See Echidna.

PORCUPINE FISH. See Diodon.

PORCUPINE RIVER, a tributary stream of the Yukon. Fort Yukon is at the confluence of these rivers. The Porcupine is navigable for steam vessels a distance of about 100 miles and for about twice that distance for smaller craft. The lower Mackenzie is most easily reached via the Porcupine, and portage to the Peel River.

PORCUPINE-WOOD, the timber of certain Oriental palms. See Palms.

PORDENONE DE SACCHIS, pôr-dā-nō'nā dā säk'kēs (or De Corticellis) really named Giovanni Antonio da Pordenone, Italian painter: b. Pordenone, 1483; d. Ferrara, January 1539. He painted in his native home and worked without much influence from abroad, until in his 27th year he visited Venice and was captivated by the productions of Giorgione, Palma and Titian. In 1535 he settled at Venice and before the end of the year was knighted by the king of Hungary (taking in addition to his own the name "Regillo"), and in 1538 was summoned to the court of the Duke of Ferrara, who desired his services to prepare designs for Flemish tapestry, but here he died suddenly the following year. These are the few incidents of his life with which we are acquainted. His works consist of altar-pieces and frescoes, painted in the spirit of the Renaissance. Of these the most important are the New Testament series of frescoes in the church of San Salvadore, Cotalto; the paintings on the walls and roof of the cathedral chapels at Treviso; and those in the cathedral of Cremona (1520–22). He also painted the altar-piece of the cathedral at Pordenone — ‘The Madonna Attended by Saints’ (1515). Most of the frescoes he painted in houses and churches at Venice have perished. Several of his paintings are in England, notably his colossal figure of ‘An Angel’ in the National Gallery, and a large picture of himself and family at Hampton Court.

PORE FUNGI. See Fungi; Polyporus.

PORGY, or **PORGEE,** name applied in different localities to any one of several different fishes. In eastern United States the scup (*Stenotomus argyrops*), and occasionally the menhaden (*Brevoortia tyrannus*) are so named. The moon-fish or angel-fish (*Chætodipterus faber*) is rarely so called. The Pagrus pagrus of European waters is called the red porgy. Consult Kingsley, J. S., ‘Standard Natural History’ (Vol. III, Boston 1885).

PORIFERA, the phylum of animals which includes the sponges, the term referring to the apertures or pores which characterize them. See Sponge.

PORISM, *in geometry,* a name given by ancient geometers to a class of mathematical propositions having for their object to show what conditions will render certain problems indeterminate. Playfair defined a porism thus: "a proposition affirming the possibility of finding such conditions as will render a certain problem indeterminate, or capable of innumerable solutions." Euclid's three books on porisms have been lost, and in consequence there has been much controversy as to what the ancients meant by the term. The porism partakes of the nature both of a problem and of a theorem, without being exactly either.

PORK, the flesh of swine, is one of the most important and widely used species of animal food. Fresh pork, though by some considered a delicacy, especially when killed young, is a much inferior article of diet to beef or mutton, and is much less used. The flesh of pork, particularly the lean, is coarser and ranker than that of the other animals chiefly used for food, but there are certain advantages which give pork a place in the supply of animal food that can be filled by no other article. The appetite of swine being much more catholic than that of their daintier neighbors, the feeding of them answers the purposes of economy, and extends very materially the supply of food. This, it is true, is attended with considerable dangers. If care is not taken that the feeding of swine should be wholesome and cleanly, their flesh becomes tainted with disease and unfit for food. Unscrupulous breeders sometimes take advantage of their exorbitant and omnivorous appetite to make them consume the most disgusting offal, and even when their feeding is not conducted with this utter recklessness of consequences it is often less careful than is consistent with sound sanitary conditions. There is in fact no animal to the perfection of whose flesh as an article of diet careful attention to feeding is more indispensable. The main recommendation of pork lies in its superiority to other kinds of animal food in undergoing the process of curing. The quality of beef and mutton is seriously deteriorated when long kept, even under the best methods of curing; that of pork is decidedly improved, and when of good quality and well cured it develops a richness and delicacy of flavor in marked contrast with the dryness and insipidity of other salted meat. Another recommendation of pork is the abundance and very digestible quality of its fat, which makes it a very suitable diet for cold climates, but which is, on the contrary, rather a disadvantage in hot ones. For long sea voyages, especially before the introduction of modern methods of keeping fresh meat, pork was by far the most common and acceptable form of animal diet, and it is still one of the most valuable items in naval stores. The swine was among the unclean animals forbidden to be eaten by the Mosaic Law. It is still regarded by the Jews as specially typical of the unclean animals. The Egyptians, Arabians and other Eastern nations had similar opinions as to the use of pork. See Hogs; Nutrition of Farm Animals; Packing Industry; Swine.

PORPHYRITE, a porphyritic orthoclase rock free from quartz; so named by some petrologists, by whom the name has been applied to various rocks generally of this character. Some of these rocks, however, include varieties in which the orthoclase constituent is more or less replaced by oligoclase. Many porphyritic dolerites have been also included under this name. By the presence of hornblende it often approaches the composition of a syenite, with which it is frequently associated.

PORPHYRY (Porphyrios), Greek philosopher of the Neo-Platonic school, celebrated as an antagonist of Christianity: b. either at Tyre, whence he is called Tyrius, or at Batanea, the Bashan of Scripture, a town of Syria, whence he is also called Bataneotes, about 233 A.D.; d. Rome, about 304. His original name was Malchus, from the Syrophœnician *melech,* king. Longinus, whose pupil he became, gave him the title of Porphyrios, that is, purple-clad. He early became the pupil of Origen, and afterward studied under Apollonius and Longinus in Athens. At 30 he came for the second time to Rome to place himself under the teaching of Plotinus. Porphyry at first disputed the doctrine taught him, in a treatise in support of the position «that the things perceived by the mind exist out of the mind,» which he submitted to Plotinus. Amelius, his associate and assistant, wrote a treatise in reply; and after some further controversy Porphyry read a recantation in the school. This incident is important, as indicating the teaching of Longinus, and possibly by implication of Ammonius, the instructor of Plotinus. Porphyry finished by entirely adopting the opinions and obtaining the confidence of Plotinus, whose literary assistant and executor he became, and whom he induced to commit his views to writing. Porphyry was naturally of a hypochrondriacal disposition, and the abtruse mysticism of Plotinus incited in him a tendency to cherish thoughts of suicide, which Plotinus perceiving recommended to him a change of situation, and about 268 he went to Sicily. Here he is said to have written his treatise against the Christians in 15 books. It was publicly burned by the Emperor Theodosius, and is known only from fragments in the authors who have refuted him. Porphyry, as well as Plotinus, recognized Christ as an eminent philosopher; but charged the Christians with corrupting his doctrines. The philosophy of Porphyry is completely identified with that of Plotinus (q.v.). Porphyry represented chiefly the religious phase of this philosophy, and we need here only refer to its relation to the popular mythology and theurgy, which has been merely adverted to in the life of Plotinus. The best ancient philosophers found no difficulty in reconciling polytheism with the belief in one supreme and omnipotent God. Plotinus and Porphyry joined a belief in good and evil demons and a respect at least for the Greek mythology with their philosophical tenets. These beliefs have been the ground of accusations of inconsistency against Porphyry, who dwells on them occasionally in his writings. He believed, as did Plotinus, in enchantment as a means of acquiring power over demons and the souls of the dead; but always ranked philosophy higher than mythology, and from his letter to the Egyptian prophet Anebo it appears that at a later period of his life doubts of the popular theology, and of the theurgical notions associated with it, had begun to prevail with him. The practical tendencies of his philosophy were ascetic. He held that all matter was polluted, and that no material sacrifice ought to be offered to the supreme God. He abstained from animal food, and would also, had it been possible, have abstained from vegetable diet. He distinguished four degrees of virtue — political virtue, or that of moderation is the first grade; purifying virtue, which sets the soul free from passion, and by means of which men are made to resemble demons, is the second grade; in the third grade, which corresponds with the absorbing devotion of philosophy, man becomes a god; and in the fourth, answering to the ecstatic state of Plotinus, he becomes the father of the gods. He recognizes a soul in animals, and accords to them a certain amount of intelligence and reason. Porphyry was a voluminous writer, but comparatively few of his works are extant. Besides his editorial work for Plotinus, the most important are his Lives of Plotinus and Pythagoras, the latter supposed to be a fragment of a larger history of philosophers. Among his other works are 'Principles Concerning Intelligibles,' a resumé of the Philosophy of Plotinus; the 'Cave of the Nymphs in the Odyssey'; four books, 'On Abstinence from Animal Food'; an 'Introduction to the Categories of Aristotle'; a 'Commentary on the Harmanica of Ptolemy,' a 10-volume work in verse, 'De Philosophia ex Oraculis Libri,' and a contribution to a symbolical interpretation of Homer. Consult Bouillet, 'Porphyre, son Role dans l'Ecole Neoplatonicienne' (1864).

PORPHYRY, any one of various kinds of compound rock having a basis in which the other contemporaneous constituent parts are imbedded. The base is sometimes claystone, sometimes hornstone, sometimes compact feldspar, jade, pitchstone, pearlstone and obsidian. The imbedded parts are commonly orthoclase feldspar and quartz; the former in more or less distinct crystals. There are porphyries of different ages. One variety is found graduating into granite and gneiss, but this does not possess the characteristics of the rock in the highest perfection; another is found in overlying strata, and unconformable to other rocks, which is the true porphyry. Its color is often red or green, and when polished it is valuable for ornamental work, being superior to marble on account of its great hardness.

PORPOISE. Any small or moderate-sized cetacean is usually called a porpoise, but the name is applied chiefly to members of the family *Delphinidæ,* belonging to the suborder *Odontoceti,* or the toothed whales. Its principal characters are as follows: The anterior pairs of ribs are joined to the vertebræ by both a tubercle and a head. The sternal ribs are completely ossified. The cervical vertebræ are more or less united. In the skull the pterygoid bones are inflated. The symphysis of the mandible is short. The teeth are always present, but vary greatly in number in different genera; they usually occur in both jaws and are simple and conical. The genus *Grampus* is without teeth in the upper jaw, and the genus *Monodon* without teeth in the lower jaw. The blowhole is single and crescentic in form.

Between 60 and 70 species of porpoises are known, representing 19 genera. They are greatly diversified in form and color. Some have a large, falcate dorsal fin, while in others the fin is reduced in size, or is represented only by a low ridge, or is entirely absent. The pectoral fins are equally varied in size and proportions, being short and broad in some forms and very long and narrow in others. The beak may be long or short, compressed or depressed, and is sometimes replaced by a narrow rim, or is absent altogether. The representatives of several genera of porpoises have received special names, such as killers (genus *Orcinus*), grampuses (genus *Grampus*), blackfish (genus *Globicephalus*), beluga or white whale (genus *Delphinapterus*), narwhal (genus *Monodon*), etc.

The *Delphinidæ* are chiefly marine, but some species of the genus *Sotalia* live in the Amazon River, and in the rivers of China, and one species af the genus *Orcäella* in the Irawadi River, Burma. The harbor porpoise (*Phocæna phocæna*) and the bottle-nosed porpoise (*Tursiops truncatus*) frequently ascend the Potomac, Hudson and other rivers of the eastern coast of the United States, and the beluga ascends the Saint Lawrence regularly every spring in large numbers.

The geographical range of the porpoises as a group extends over all seas from the Arctic to the Antarctic, but while some species, such as the common dolphin (*Delphinus delphis*) have a very wide distribution, that of others is more circumscribed. Thus, the narwhal is confined to the Arctic Ocean, and rarely leaves the ice. The beluga is also an Arctic species, though it ranges southward regularly in spring to the Saint Lawrence, as already stated, and occasionally individuals stray as far south as Cape Cod and the New Jersey Coast. The white-lipped porpoise (*Lagenorhynchus albirostris*) is common about the British Isles, but is not found on the coast of the United States. The species of blackfish (*Globicephalus melas*) found on our east coast north of New Jersey is different from that occurring further south. Our commonest east coast porpoise (*Tursiops truncatus*) is not found in Greenland waters, while the harbor porpoise (*Phocæna phocæna*), which is abundant in the gulf of Maine and northward, does not range south of New Jersey. Many species occurring in the tropics and the south seas are never seen in North American waters.

The majority of porpoises feed upon fish, but the various species of blackfish, the narwhal and the white whale subsist chiefly or exclusively upon cuttlefish, while the killers devour the young or other cetaceans and of various amphibious mammals, such as seals, sealions, etc. The stomach of a porpoise (*Sotalia teüssii*) recently discovered on the west coast of Africa was found to contain leaves of the mangrove tree and other vegetable matter. Porpoises are gregarious animals, congregating in large herds or «schools,» which sometimes comprise an enormous number of individuals. Schools of blackfish numbering hundreds of individuals occasionally approach the land at the Faroe Islands, the Orkney Islands, Cape Cod, and other points, where they strand, or are driven ashore by the fishermen. They are the source of a considerable profit, on account of their oil, which is of a superior quality. The skins of the blackfish and of the white whale are valuable for leather, but the dermis of the majority of porpoises is too thin, or too irregular in texture, to form good leather.

Besides the porpoises of the family *Delphinidæ,* there are a few species generally called river dolphins representing three genera, which belong to a separate family, the *Platanistidæ.* The best known are the susu of the Ganges River, genus *Platanista,* a blind form which subsists chiefly upon fresh-water crustaceans; the inia, genus *Inia,* of the Amazon River; and the *Pontoporia,* found about the mouth of the La Plata River. These porpoises are remarkable for their long beaks, their broad pectoral fins, their free cervical vertebræ, and their rugose or otherwise peculiar teeth. They are regarded as highly specialized forms of ancient origin. Numerous fossil species of *Delphinidæ* and *Platanistidæ* occurs in the Tertiary and latter geological formations, beginning with the Miocene. Consult Beddard, F. E., 'A Book of Whales' (London 1900); Goode, G. B., 'Fishery Industries' (Washington 1884); True, F. W., 'Bulletin of the United States National Museum, No. 36' (Washington 1889).

PORPORA, pōr'pō-rä, **Nicolo,** Italian composer: b. Naples, 19 Aug. 1685; d. there, February 1766. He studied under Scarlatti and his first opera, 'Ariana e Teseo,' was brought out at Vienna, 1717. In 1725 Porpora went to Vienna with his celebrated pupil, Farinelli, and in 1728 accepted a pressing invitation from the court at Dresden. He had already composed 50 operas, and was regarded as without a rival. In 1729 a faction in London, discontented with Handel, opened another opera house, and called Porpora to take the direction of it. Porpora, supported by Farinelli and other distinguished singers whom he had trained, triumphed, and Handel accordingly gave up the theatre, and devoted himself to oratorio. Porpora now gave up his engagements in Dresden, and established himself in London. Here his reputation, especially as a singing-master, continued to be great; but after a few years he went to Venice and later was established in Vienna where in 1754, Haydn, for the sake of obtaining his instructions, became his valet. In 1760 he presided at the production in Naples of his last and feeblest opera, 'Il Trionfo di Camillo.' Only a few of his operas are now known, and none of them have retained popularity; but he is regarded as the most accomplished singing-master who has ever existed. His religious compositions, and especially his cantatas, are the works in which he appears to most advantage. Besides the 50 operas, he composed six oratorios, many masses and other church music, and numerous cantatas, and published six 'Sinfonie da camara.' Consult Marchese Villarosa (in 'Memorie dei compositore,' 1840, and Clément (in 'Musiciens célèbres').

PORRAS, pôr'räs, **Belisario,** Panaman statesman: b. Panama, 1860. He received his education at Bogotá and Brussels; was counsel for the French Canal Commission, and professor of international law at the Universities of San Salvador and Managua. He subsequently became judge of the Supreme Court of Colombia and served his country as consul-general in Belgium. He was Panaman delegate to the Hague Peace Conference in 1907 and in 1910–11 was the Panaman Minister at Washington, D. C. In 1912 Mr. Porras was chosen president of Panama.

PORRO, pôr'rō, **Count,** Italian general: b. Bologna, 1854. He passed through the Turin Military Academy and received his commission as sub-lieutenant of artillery at the age of 22. On reaching the rank of colonel, he was nominated to the General Staff and later acted as director of the War School and under-secretary of war in the Second Fortis cabinet (1905–06). Promoted lieutenant-general in 1911, he commanded divisions at Verona and Milan, and was offered the portfolio of War in the Salandra cabinet. In 1915 he became under-chief of Staff. Together with General Cadorna (q.v.) he was relieved of his command after the Italian defeat on the Isonzo in October 1917, and in July 1918 both officers were placed on the retired list with loss of rank and pay. General Capello suffered the same fate.

PORSENA, pôr'sē-na, or **PORSENNA**, **a Lars** (or «mighty lord»), king of the Etrurian city of Clusium. According to the legend narrated by Livy, he received the Tarquins on their expulsion from Rome (B.C.) 508, and after endeavoring in vain to effect their restoration by negotiation, advanced with an army to Rome. He would have entered the city with the flying Romans had not Horatius Cocles disputed the passage until the bridge was broken down. Porsena then besieged Rome, and a famine was produced in the city, when another Roman youth, Mucius Scævola, gave striking proof of his patriotism. (See SCÆVOLA). A truce was now agreed upon, and the Romans sent 10 young men, and as many girls, as hostages to the Etrurian camp. The latter escaped to Rome by swimming across the Tiber, but the consul Publicola conveyed them back again to Porsena, and was on this occasion treated with the greatest indignity by the Tarquins. Indignant at the perfidy of the Tarquins, and respecting the magnanimity of the Romans, Porsena separated himself from the former, and concluded peace with the latter without taking away their hostages. To relieve the wants of the Romans without offending their pride by a formal present, he left behind at his departure his camp with all its stores, and in remembrance of his magnanimity the senate erected to him a monument, and presented him with an ivory chair and sceptre, a golden crown and a royal robe. Thenceforward Porsena lived in undisturbed friendship with the Romans. The accounts in Dionysius (v, 33), Plutarch ('Publ.' 19) and Livy ('Hist. Natl.,' xxxiv, 13) will be found to be inconsistent with one another. Modern critics have held that Rome was completely conquered by Porsena, and that the gifts they are represented as offering from gratitude were really a tribute indicating subjection. Aruns, the son of Porsena, was defeated by a league of the Latin cities, after which the Romans are believed to have recovered their independence. According to Pliny, Porsena forbade the Romans the use of iron, except for agricultural purposes.

PORSON, Richard, English Greek scholar: b. East Ruston, Norfolk, 25 Dec. 1759; d. London, 25 Sept. 1808. He was educated at Eton and Cambridge, took the degree of M.A. in 1785, and not choosing to take holy orders, on account of conscientious scruples in regard to signing the 39 articles was obliged to relinquish the fellowship he had held from 1781. In 1792 he was appointed Greek professor, and in 1794 began the publication of the Tragedies of Euripides, with annotations, but continued his labors only through four—'Hecuba,' 'Orestes,' 'Phœnissæ' and 'Medea.' He assisted in editing the Grenville Homer (1800), and corrected the texts of the tragedies of Æschylus for an edition which issued from the Foulis Press at Glasgow. He had the reputation of being one of the best Greek scholars and critics of the age, notwithstanding which he experienced little patronage, a circumstance partly attributable to his intemperate habits. He was the author of 'Letters to Archdeacon Travis, in Answer to his Defense of the Three Heavenly Witnesses' (1790, 8vo.), in which he is allowed to have proved that the received text of 1 John v, 7, 8 is spurious. After his death were published his 'Adversaria, or Notes and Emendations of the Greek Poets'; and his 'Tracts and Miscellanies' (1815). In Porson acute discernment and solid judgment were united to intense application and a stupendous memory. Consult Watson, 'Life of Richard Porson' (1861).

PORT. See HARBORS, DOCKS AND BREAKWATERS; SHIPBUILDING; ETC.

PORT ADELAIDE, Australia. See ADELAIDE.

PORT ARTHUR, Canada, city and port of entry in Thunder Bay District, province of Ontario; on Lake Superior; the lake terminus of the Canadian Northern, also on the Canadian Pacific, and the Grand Trunk Pacific railways, about 200 miles northeast of Duluth, Minn., and about 500 miles from Manitoba. It is the principal commercial point on the northwest shore of Lake Superior. It is in a lumbering region and valuable mines of gold, silver and iron are adjacent. Large shipments of merchandise, coal, wheat, etc., are made to eastern ports. Iron is smelted here. The city is the iron centre of the north shore and district, and there are also foundries, blast furnaces, brick yards and other manufactories, railway coal and ore docks, lumber yards, refrigeration plants, etc. Port Arthur has several churches, a high school, public schools and a Separate school, public library, armory, sailors' institute, Y. M. C. A. buildings, and district courthouse. The city was first settled in 1870, became a borough in 1884, and a city in 1907. The government is vested in a mayor and council of 10 members. The city is the county-seat for judicial purposes. Pop. 18,500.

PORT ARTHUR, or **LU-SHUN-KOU**, Manchuria, a strongly fortified seaport town at the southern extremity of the Liao-tung peninsula, dominating the Lao-tie-shan channel entrance to the Gulf of Pe-chi-li from the Yellow Sea and Korea Bay. Prior to its capture by the Japanese in the War of 1894 it was a Chinese fortress and naval arsenal. Its occupation by the Japanese was prevented by the Russian, German and French coalition, but on 27 March 1898, the Chinese government leased it to Russia with adjacent territory for 25 years. Under the Russians it became the terminus of a railway line connecting with the Trans-Siberian Railway, the Chinese railway systems, and with modern Dalny, the important commercial seaport city, 14 miles to the northeast. It was fortified, its harbor and dock accommodations extended, and it was considered one of the strongest fortresses and navel stations in Chinese waters. At the outbreak of the Russo-Japanese War in 1904, it was the scene of a series of disasters inflicted on the Russian navy, not only by the torpedo boats of the enemy, but also by their own submarine mines and forts. It was surrendered to the Japanese, 3 Jan. 1905, after a remarkable siege, for the term of the Russian lease (25 years from 1898). The lease was extended in 1915, undue pressure being put on China by the Japanese. Pop. 17,000. See CHINA; DALNY; JAPAN; MANCHURIA.

PORT ARTHUR SHIP CANAL, Texas, an artificial waterway, named after the town of Port Arthur, Tex., which is situated on Sabine Lake, a body of water three miles long and 10 miles wide, which marks the boundary of Texas and Louisiana. Seven and one-half miles from Port Arthur Sabine Lake narrows into a long channel called Sabine Pass. This channel is from 26 to 40 feet deep and extends for seven miles to the south, terminating in the Gulf of Mexico. At the outer end of the pass is a bar which has been pierced by a channel formed by extending for a mile or more from shore two jetties of piled stone built by the United States government. The jetties narrow the entrance to the pass from the Gulf, and the wash of the imprisoned waters to and fro, with the ebb and flow of the tide, scoured a channel over the bar of 16 to 25 feet deep. The opening of this canal signalized the creation of a new seaport on the Gulf for the largest ocean vessels, the connection of a land-locked fresh-water harbor with the terminus of a great railway system, and the reduction by 500 miles of the distance over which the export food products of the southwest States have been hauled by east and west lines. The canal was formally opened 25 March 1899. In 1912 further operations were begun to obtain a channel of 26 feet navigable depth, and 150 feet wide, a turning basin 25 feet deep, 600 feet wide and 1,700 feet long, to cost $2,000,000, and with $190,000 annually for maintenance. The work was completed in 1915.

PORT BLAIR, the principal port of the Andaman Islands (q.v.) on South Andaman. It is connected with Calcutta, Rangoon and Madras by a mail steamer line; has a fine harbor with safe anchorage, and is an important penal settlement.

PORT BRETON, a name given to the southeast part of New Mecklenburg (formerly and again called New Ireland), in the Bismarck Archipelago off Kaiser Wilhelm Land, New Guinea, the scene in 1879 of a disastrous colonizing experiment by a company of French Legitimists. In 1883, the Marquis Du Rays, who floated the company, and his associates were condemned to various terms of imprisonment for fraud and raising money by false pretenses. German New Guinea was occupied by an Australian force 12 Sept. 1914, and came under British military occupation.

PORT CARBON, Pa., borough in Schuylkill County, on the Schuylkill River, and on the Philadelphia and Reading Railroad, about two miles northeast of Pottsville. There are ironworks within the boroughs, but the mining of coal is the chief industry. Pop. 2,678.

PORT CHESTER, N. Y., village, Westchester County, on Long Island Sound, and on the New York, New Haven and Hartford Railroad, 26 miles northeast of New York City. It was settled in the middle of the 18th century, and was at first called Saw Pit; the name was changed in 1837, and the village incorporated in 1868. It contains foundries, screw and bolt factories, carriage works, shirt factories and a woolen mill. It is also a summer resort. It contains a public hospital, also a public library and high school which has its own school library. The village is governed by a president and a board of trustees, all holding office for two years. Pop. 15,000.

PORT CLARENCE, Alaska. See CLARENCE HARBOR.

PORT CLINTON, Ohio, village, county-seat of Ottawa County, on Lake Erie at the mouth of the Portage River, and on the Lake Shore and Michigan Southern Railroads, 64 miles west of Cleveland. It has a good harbor and carries on a considerable lake trade, being the commercial centre of a region where the chief industry is grape and peach culture; lime and building stone are also obtained in the vicinity, and gypsum is mined. Fruit baskets are manufactured, and the fisheries are also of commercial importance. The village contains a public high school. Pop. 3,007.

PORT DARWIN, Australia, one of the finest harbors of the Commonwealth, on the north coast of the state of South Australia. Its entrance is two miles wide, and vessels of any tonnage can float in it with safety. Palmerston, the chief town on its shores, is the land terminus of the overland telegraph, 1,973 miles from Adelaide, and of the cable to Java. Since 1891 it is also the starting point of a railway to the gold fields of the interior, 150 miles distant.

PORT ELIZABETH, South Africa, a seaport city of Cape Colony, on the west side of Algoa Bay, about 420 miles east of Cape Town. It has many fine buildings, including a handsome town hall, custom-house, hospital, college, public library, museum, Grey Institute, and several churches, etc. It is the great centre of trade for the eastern portion of the colony as well as for a large part of the interior, being the terminus of railways that connect it with Kimberley and other important inland towns. The exports and imports together amount to over $50,000,000. There are a seawall and two iron jetties, but the shipping is much exposed to easterly winds and extensive harbor works are being built. Pop. 18,190.

PORT ESSINGTON, Australia, an inlet in the Coburg Peninsula of the northern territory of South Australia, on the Arafura Sea, forming a fine harbor. The British Government had a penal settlement on its shores from 1831 to 1850.

PORT FAMINE, Chile, a deep bay on the east coast of the Straits of Magellan, so named in 1587 by Cavendish. It was a Chilean penal colony in 1843–53.

PORT GIBSON, Battle of. After much unsuccessful effort to reach Vicksburg from the north, General Grant, late in January 1863, directed his attention to opening a canal which had been begun the year before across the peninsula on the west bank of the Mississippi. The canal proving impracticable and other plans failing, among them an expedition up the Yazoo River, Grant determined to move his army by land down the west bank of the river some 70 miles and across the Mississippi below Vicksburg, while transports for crossing should run past the Vicksburg batteries. Admiral Farragut had already run two of his vessels past the

Confederate batteries at Port Hudson and Grand Gulf, and cleared the river of the enemy's boats below Vicksburg. On the night of 16 April, Admiral D. D. Porter ran the Vicksburg batteries with a fleet of six vessels and three transports carrying stores, one of the transports being lost. Six days later, five more transports, towing 12 barges, ran the batteries safely, a sixth being sunk and half the barges disabled. Meanwhile, Grant had marched McClernand's and McPherson's corps from Milliken's Bend for New Carthage, and upon arriving at that place and finding a limited number of transports the troops were marched to Hard Times, where a number of boats were collected from the different bayous in the vicinity, and 29 April, having 10,000 troops on barges and transports, Grant was opposite Grand Gulf, prepared to land and carry the place by storm the moment the batteries beating on the river had been silenced by the navy. Admiral Porter, with seven ironclads, opened the attack at 8 A.M., and engaged at close quarters until 1.30 P.M.; but from the great elevation of the Confederate batteries, he found it impracticable to silence them with his guns, and therefore withdrew, when Grant immediately decided to land his men on the Louisiana shore and march them across the point to below Grand Gulf, the gunboats and transports to run the batteries. At dusk the gunboats engaged the batteries, and all the transports ran by, the gunboats following. Grant had heard of a good landing on the east bank of the river, and at daybreak of the 30th transports and gunboats began the ferrying of the troops across to Bruinsburg, 10 miles below Grand Gulf and 32 in a straight line below Vicksburg. At noon McClernand's corps, four divisions, 18,000 men, had been landed, and at 4 P.M. McClernand pushed out into the country, and at 1 A.M. of 1 May met the Confederates 12 miles from Bruinsburg and four from Port Gibson, and after slight skirmish the advance division, under General Carr, lay on its arms until daybreak. The Confederate force met was General Green's brigade, which had marched from Grand Gulf on the afternoon of the 30th. During the night it was joined by General Tracy's brigade from Vicksburg, and line was formed about three miles west of Port Gibson, across two roads converging on the town and uniting just outside of it. Green was across the southern road, and Tracy across the northern one, the roads running on two ridges, separated by a deep ravine, filled by a dense growth of cane and underbrush. At 5 A.M. 1 May the battle was opened by the advance of Osterhaus' division on the left, which was checked and repulsed by Tracy's brigade with much loss, and made no further progress until late in the afternoon. Carr's division, supported by Hovey's, advanced on the right and assaulted the ridge held by Green's brigade, and after a hard fight carried it, capturing two guns and over 300 prisoners, Green falling back toward Port Gibson. Gen. J. S. Bowen, commanding the Confederate forces at Grand Gulf, arrived on the field with General Baldwin's brigade, about 9 A.M., and formed line in Green's rear, Carr and Hovey continued to press Green, who was soon withdrawn and sent to assist Tracy, leaving Baldwin to oppose them. Early in the afternoon Baldwin was attacked, and a severe contest ensued, lasting nearly two hours, during which Bowen, with two regiments of Col. F. M. Cockrell's brigade, which had arrived about noon, made a very determined effort to turn McClernand's right, but the attempt was defeated, and Cockrell's men joined Baldwin. Meanwhile, Logan's division of McPherson's corps had come up and, part of it joining Osterhaus, both advanced on Tracy's and Green's brigades and slowly forced them back. McClernand's troops on the right again attacked Baldwin, and just at sunset the entire Confederate force, Baldwin covering the rear, fell back through Port Gibson and destroyed the bridge over the south fork of Bayou Pierre, two miles beyond Port Gibson. Grant entered the place next morning. The Union forces engaged were four divisions of McClernand's corps and part of Logan's division of McPherson's, in all about 23,000 men, and their losses were 131 killed, 719 wounded and 25 missing. The Confederate forces, under Bowen, were four brigades of 6,000 men and 13 guns. They lost five guns and reported 68 killed, 380 wounded and 384 missing. Consult 'Official Records' (Vol. XXIV); Greene, 'The Mississippi'; Grant, Ulysses S., 'Personal Memoirs' (Vol. II); 'Battles and Leaders of the Civil War' (New York).

E. A. CARMAN.

PORT-GLASGOW, Scotland, a seaport town of Renfrewshire, on the estuary of the Clyde, 20 miles west-northwest of Glasgow and about two and a half miles above Greenock. In 1662 the magistrates of Glasgow purchased here 13 acres of land on which they built harbors and the first drydock in Scotland. The town was intended to be the seaport of Glasgow and long did a large shipping trade; but when the Clyde was deepened so as to enable large vessels to sail up to Glasgow the trade rapidly diminished. The staple industries are shipbuilding and marine engineering, and there are manufactures of sail-cloth, ropes, etc., iron and brass foundries, bolt and rivet works. Pop. about 18,000.

PORT HAMILTON, Chosen, formerly Korea, a spacious, well-sheltered harbor, formed by three islands of the Nanhow group in the Chosen or Korean archipelago, 30 miles south of Chosen or Korea and 45 miles northeast of Quelpart Island. It was explored and named by Belcher in 1845. In 1885 it was annexed by Great Britain as a prospective coaling station, but was abandoned the following year.

PORT HOPE, Canada, town, port of entry in Durham County, in the province of Ontario, on Lake Ontario, and on the Grand Trunk Railroad, about 60 miles east by north of Toronto. There are steamer connections with the principal lake ports and there is here a good harbor. The chief industries of the place are fishing (it has a large fishing fleet), and manufacturing of leather, machinery, steam engines, iron castings, buttons, woolen goods and woodenware. There is a large trade in its own manufactures, grain and lumber. Pop. 5,092.

PORT HUDSON, Siege of. Port Hudson, a small village of East Baton Rouge Parish, La., on the east bank of the Mississippi, 135 miles above New Orleans, was occupied by the Confederates, under General Breckinridge, after their defeat at Baton Rouge, 5 Aug. 1862. The place was in a sharp bend of the river, on bold bluffs rising 75 to 90 feet above it, which for three miles along the river were strongly fortified and armed with heavy guns. In November 1862 General Banks was ordered to relieve Butler, in command at New Orleans, under instructions from Halleck requiring Banks to clear the Mississippi River, also to occupy the Red River country as a protection for Louisiana and Arkansas and as a basis for future operations against Texas. He was authorized to assume control of any military forces from the upper Mississippi which might come within his command, and to exercise superior authority as far as he might ascend the river. When these instructions were issued General McClernand had been given authority to organize an expedition on the upper Mississippi to reduce Vicksburg, and the intention was that Banks should ascend the river from New Orleans, join forces with McClernand at Vicksburg, and assume command for operations against that place. When Halleck gave the instructions he did not suppose that there were any barriers on the river that would seriously interfere with Banks' movement to Vicksburg. Banks arrived at New Orleans with about 20,000 men 14 December, relieved Butler, and was surprised to learn that the Confederates held Port Hudson, with 21 heavy guns on the bluffs and a garrison reported as numbering from 12,000 to 16,000 men. Nothing was heard from McClernand or Grant. On the 18th General Grover, with a division of 18,000 men and some artillery, was sent to occupy Baton Rouge, 25 miles south of Port Hudson, which was accomplished without opposition and was the first step in the reduction of Port Hudson.

After providing for the security of New Orleans, Banks organized his available forces into a corps of four divisions, under command of Generals Augur, Thomas W. Sherman, Emory and Grover. Exaggerated reports of the strength of the Confederates at Port Hudson forbade a direct attack upon it, and Banks endeavored to turn it on the west and reach Vicksburg by means of the Atchafalaya, the mouth of Red River and the various bayous connecting the Atchafalaya with the Mississippi, but was unsuccessful, and was turning his attention to a movement from Berwick Bay by the Atchafalaya, when news came that two of Colonel Ellet's rams, after running the batteries of Vicksburg, had been captured. Admiral Farragut, who was co-operating with Banks, now proposed to run his fleet past the batteries of Port Hudson, recapture or destroy the rams and thus control the river as far up as Vicksburg, and cut off supplies from the Red River country. Banks promptly assented and moved from Baton Rouge, with 17,000 men, to the rear of Port Hudson, on 14 March 1863, to co-operate with the fleet. That night Farragut started to run the batteries with nine vessels, carrying 116 guns. Most of the fleet, under the heavy fire brought to bear upon them, failed to get through, and put back; the *Mississippi* passed the lower batteries, then ran aground and, being under fire of three heavy batteries, was burned by her commander, the crew taking to boats and going back; the *Hartford* and *Albatross* made the passage and communicated with Porter's fleet above Vicksburg. Farragut's loss was 113 killed and wounded; one vessel had been destroyed and four disabled. The navy now had control of the mouth of Red River, and Banks, reverting to the execution of his turning movement by the Atchafalaya, recrossed the Mississippi, drove back the Confederate forces of Gen. R. Taylor, after two severe engagements at Fort Bisland and Irish Bend, in which he lost 353 men, and occupied Opelousas 20 April, from which place he marched to Alexandria, on Red River, reaching there 7 May, Taylor retiring before him to Shreveport and into Texas. He had captured a large number of prisoners and 22 guns, and Farragut had destroyed three gunboats, including those that had been taken from Ellet. Meanwhile he had received word from Farragut that Grant, 23 March, had written him that should river transportation be secured he would send 20,000 men through the Tensas, Black and Red Rivers to join in reducing Port Hudson, and at the same time a letter from Grant that he could spare him an army corps to enable him to get up the Mississippi. Upon arriving at Alexandria, Banks received a dispatch from Grant, dated at Milliken's Bend 14 April, proposing to send an army corps to Bayou Sara by the 25th, and requesting that Banks should, after the reduction of Port Hudson, send all the troops he could spare to Vicksburg. Banks assented to the proposition, saying that the troops could be shipped from New Orleans, but he was afterward informed by Grant, in a dispatch dated Rocky Springs 10 May, and received on the 12th that he had crossed the Mississippi to Grand Gulf and was then in close pursuit of the enemy and, under the circumstances, could not retrace his steps, nor send the promised troops; and as he had heard and believed that Port Hudson was almost entirely evacuated, he requested Banks to join his command at Vicksburg. Regarding the proposed co-operation Grant says: «While at Grand Gulf (3 May) I heard from Banks, who was on the Red River, and he said that he could not be at Port Hudson before the 10th of May, and then with only 15,000 men. Up to this time my intention had been to secure Grand Gulf as a base of supplies, dispatch McClernand's corps to Banks and co-operate with him in the reduction of Port Hudson. The news from Banks forced upon me a different plan of campaign from the one intended; to wait for his co-operation would have detained me at least a month. . . . I therefore determined to move independently of Banks.» Halleck was intensely provoked at the action of Grant and Banks, and wrote sharply to both of them. That it was his intention that their two armies should unite or co-operate under the chief command of Banks, and first take Port Hudson, is evident from his letters. To Grant he wrote 11 May, after he knew that he was operating in rear of Vicksburg, that his forces and those of Banks should be concentrated between Port Hudson and Vicksburg, so as to attack these places separately with the combined armies. Grant says that he received this letter on the Big Black on the 17th, and that in it he was ordered «to return to Grand Gulf and to co-operate from there with Banks against Port Hudson, and then to return with the combined forces to besiege Vicksburg.» To Banks, Halleck wrote a few days later: «I assure you that the government is exceedingly disappointed that you and Gen. Grant are not acting in co-operation. I thought to secure that object by authorizing you to assume the entire command as soon as you and Gen. Grant could unite." When these letters were received both Grant and Banks had fully committed themselves to the independent sieges of Vicksburg and Port Hudson.

The failure of Grant to co-operate with him was a keen disappointment to Banks. He could not join Grant for want of water transportation; he could not leave Port Hudson, with its large garrison in his rear, without endangering New Orleans and all the Red River region; and, therefore, he concluded to concentrate his command and move immediately against Port Hudson. On 14 May he marched from Alexandria for Bayou Sara, crossed the Mississippi on the night of the 23d, and on the night of the 24th was in rear of Port Hudson, where he was joined next day by General Augur, who had come up from Baton Rouge, defeating the Confederates at Plains' Store, on the 21st, with a loss of 86 killed and wounded, the Confederate loss being about the same. The investment was completed on the 26th with about 14,000 men, Gen. Frank Gardner, commanding at Port Hudson, having about 7,000 men. Gardner had been ordered by Gen. J. E. Johnston, 19 May, to evacuate the place forthwith and move toward Jackson, but the order came too late. Under the impression that Gardner's force was much less than it was in reality, as it was reported much reduced by troops sent to oppose Grant in rear of Vicksburg, Banks ordered a general assault to be made on the morning of the 27th. The Confederate fortifications on the land side of Port Hudson consisted of a series of strong works connected by rifle-pits, with their flanks resting on the river above and below the place. Their length was nearly four miles, and upon them were about 30 field-guns. The approach to them was difficult, being cut by ravines and for the most part covered by dense groves of magnolia and other trees. The investing line was seven miles in length. The brigade of General Weitzel and the divisions of Generals Dwight and Grover were on the right, Augur's division in the centre, and a part of Thomas W. Sherman's on the left. The assault, which was ordered simultaneously along the entire line, was preceded by a heavy fire of artillery, and at 10 A.M. Weitzel, on the right, commanding his own troops and Dwight's, moved forward fighting severely until late in the afternoon, and gaining some ground; Grover, on his left, gained and held commanding positions within 200 yards of the Confederate works. In the centre and on the left Augur and Sherman did not advance until 2 P.M., when they made a most determined effort, under a severe fire of canister and musketry, and reached the ditch of the works, but could not cross the parapet, and were withdrawn at night. The only advantages gained were the advanced positions held by Weitzel and Grover. The Union loss in the assault, in which 13,000 men participated, was 293 killed, 1,545 wounded, and 157 missing. The Confederate loss was about 235 killed and wounded. Regular siege operations began next day, siege-guns were planted, and constant skirmishing was kept up, during which, with some checks, the Union lines gained some ground, which was immediately intrenched. On 10 June a heavy artillery-fire was kept up and at 3 o'clock on the morning of the 11th an attempt was made to get within assaulting distance of the works. A portion of the troops worked their way through the abatis, but were repulsed with loss and some captured. Meanwhile Banks had reorganized his command. Sherman, who had been severely wounded on the 27th of May, was succeeded by General Dwight, and General Grover was assigned to the command of the right wing, consisting of his own and Paine's division and Weitzel's brigade. The line was formed in this order from right to left: Weitzel, Grover, Paine, Augur and Dwight. On 14 June, the line of investment being well advanced, Banks made a second general assault at daylight from his left and right. Dwight, on the left, endeavored to gain entrance to the works by passing a ravine, while the main attack was made on the right by Grover and Weitzel. The assault ended in a bloody repulse, the Union loss being 203 killed, 1,401 wounded, and 188 missing. The Confederates had 22 killed and 25 wounded. The only advantage gained was a few yards nearer approach to the works on the right, and on the left an eminence commanding a strong part of them, and which later enabled Banks to get possession of the bluff within 10 yards of the enemy's lines. Siege-operations were continued and on the right saps were run to the very line of the Confederate works. On the left a mine had been prepared for a charge of 30 barrels of powder, and a storming column of 1,000 volunteers organized, when, during the night of 6 July, news was received that Vicksburg had surrendered. Gardner soon heard the news, and asked Banks to give him an official assurance of its truth, adding that if true, he requested a cessation of hostilities with a view to consider terms for a surrender. Banks furnished him a copy of Grant's despatch, terms were agreed upon, and on the 8th Gardner surrendered 6,340 officers and men, 51 guns, about 7,500 muskets, large quantities of ammunition, and two river steamers. In an address commending the gallantry of his men, Gardner stated that his surrender was not on account of the fall of Vicksburg, nor for want of ammunition or provisions, but was due to the exhaustion of his men, who had been without rest for more than six weeks, and who could not resist another attack. In all the operations against Port Hudson the fleet under Farragut had co-operated and assisted. The Union loss during the siege was 708 killed, 3,336 wounded and 319 missing, an aggregate of 4,363. Incomplete Confederate returns show a loss of 176 killed and 447 wounded. Consult 'Official Records' (Vol. XXIV, XXVI); Greene, 'The Mississippi'; Grant, 'Personal Memoirs,' (Vol. I); The Century, 'Battles and Leaders of the Civil War' (Vol. III).

E. A. CARMAN.

PORT HURON, Mich., city, port of entry, county-seat of Saint Clair County, at the mouth of Black River, the head of Saint Clair River, and at the foot of Lake Huron, on the Grand Trunk Western, and Grand Trunk, The Detroit, Bay City and Western, and the Pere Marquette railroads, about 58 miles northeast of Detroit. Port Huron is the most easterly point in the State. It has steamer and electric railway connection with Detroit, and steamer connection with all the principal ports of the Great Lakes. A railroad tunnel under the Saint

Clair River extends from Port Huron to Sarnia, Ontario. This tunnel is over a mile long directly across, but including the approaches it is nearly two miles long. It cost about $2,700,000, and was opened in 1891. The climate, scenery, mineral springs and opportunities for fishing have combined to make Port Huron a favorite summer resort. It has considerable manufacturing interests; the chief industrial establishments are shipbuilding works, knitting mills, overall factory, paper mill, wire fence factory, two large foundries, engine and thresher works, Grand Trunk car and locomotive shops, fibre works. Port Huron has an extensive commerce, especially with Canada. The exports in a recent year were valued at $37,000,000 and the imports at $8,100,000. The principal public buildings are the custom-house and post office, courthouse, auditorium, hospital and home, the Carnegie Library, and two Maccabee Temples. The educational institutions are several public schools, including two high schools. The city has just voted to build another $100,000 high school. The commission form of government is in operation. In 1686 the French under Duluth built a fort here but it was maintained for two years only. The United States built Fort Gratiot on the site in 1814 and maintained it until 1879. The village of Port Huron was organized in 1849 and became a city under a charter of 1857. Pop. 18,863.

PORT ISABELA, ē-sä-bā'lä, Philippines, harbor in channel between Malamaui Island and the northwest coast of the island of Basilan. It has a naval hospital, a small arsenal and equipment for the repair of small vessels. The town Isabela de Basilan is the capital of the island. Pop. about 1,331.

PORT JACKSON, Australia, the beautiful and extensive inlet on the east coast in New South Wales, forming the well-sheltered harbor on the south shore of which Sydney stands. See SYDNEY.

PORT JACKSON SHARK. See CESTRACION.

PORT JERVIS, N. Y., city in Orange County, on the Delaware and Neversink rivers, where the States of New York, New Jersey and Pennsylvania meet, and on the New York, Ontario and Western railroads, 88 miles northwest of New York City. It was settled in the last of the 18th century, and laid out as a village in 1826. The first permanent settlers were descendants of the French Huguenots and the Dutch, who settled the town of Deerpark. It is a popular summer resort on account of the many waterfalls nearby and the beauty of the scenery in general. Its water-power and transportation facilities have contributed toward making the village of commercial and industrial importance. The chief manufacturing establishments are railroad shops, glove factories, silk mills, silver plating works, necktie factory, overall factory, saw factory, shirt factory, and other industrial works are a flour and planing mills, sash factory, printing works and a number of smaller establishments which supply local needs. The principal public buildings are the Carnegie Free Library, cost $30,000; Port Jervis chamber of commerce, two hospitals, the Y. M. C. A. building, Saint Mary's Orphan Asylum, and churches of several denominations, Elks Home, Federal building, and a new $35,000 parochial school. The educational institutions are public and parish schools, a new high school, two private schools, a conservatory of music and the public library. In recent years the city has paved several streets with brick, erected an electric-light plant, and installed a new electric-lighting system. The Erie Railroad whose interests are closely identified with those of the city has erected a monument to the founders of the city. The demand for extra housing facilities has resulted in increasing activity in building operations. Pop. 9,564.

PORT LOUIS, loo'ĭs or loo'ē, Mauritius, capital of the British colony of Mauritius; on the northwest coast, on a cove formed by a series of basaltic hills, portions of which are covered with forest. The streets are narrow, laid out at right angles with basaltic curbstones, and shaded by large acacias. A mountain stream traverses the town. The town and harbor are protected by Forts Adelaide and George. The principal buildings and institutions are the Roman Catholic and Protestant cathedrals, the barracks, theatre, hospital, botanical gardens, an observatory and library. It is the chief commerical port of the island and a coaling station for the British navy. Great damage and loss of life were caused by a hurricane in April 1892. Pop. (with suburbs) 50,060. Consult Flemyng, 'Mauritius, or the Isle of France'; Decotter, 'Géographie de Maurice et de ses Dépendances.'

PORT MAHON. See MAHON.

PORT-MOODY, Canada, a harbor at the head of Burrard Inlet, British Columbia, a little to the north of New Westminster. It was at one time intended for the terminus of the Canadian Pacific Railroad, but was abandoned for Vancouver, at the entrance to Burrard Inlet.

PORT NATAL, nạ-täl', South Africa. See DURBAN.

PORT ORCHARD (formerly Sidney), Wash., a United States naval station in Kitsap County, on Port Orchard Bay, an inlet of Puget Sound, about 20 miles west of Seattle. The station was established in 1891, when the government purchased here 200 acres of land, built a dry dock 600 feet long and 75 feet wide, and capable of holding vessels with a 30-foot draft. The original cost of the improvements, not including purchase price of land, was $700,000.

PORT DE PAIX, pŏr dė-pā, Haiti, town on the Tortuga Channel, and on the right bank of Trois Rivières, about 95 miles north of Port-au-Prince. The place was visited by Columbus in 1492, and by him was named Valparaîso. It is in an agricultural region, in which coffee is the principal production. There is a large trade in coffee and fruit. Pop. estimated at about 10,000.

PORT PHILLIP, Australia. See MELBOURNE.

PORT-AU-PRINCE, pōrt'ō-prins' (Fr. pōr-tō-prăṅs), or **PORT RÉPUBLICAIN,** pōr-rā-püb-lē-käṅ, Haiti, city, capital of the Republic of Haiti; on the Bay of Haiti. It is the principal seaport, and although it has an excellent harbor, the low marsh land surrounding it renders it undesirable as a place of residence.

The buildings are mostly of wood. There is considerable trade in fruits, the cocoanuts, and cabinet woods. It has municipal buildings, a mint, college and lyceum. The city was founded in 1745, and was completely destroyed by an earthquake in 1770. It has also been ravaged bv fires in 1791, 1843 and 1867. In recent local disturbances it was occupied by American marines. Pop. about 100,000.

PORT REPUBLIC, Battle of. Gen. «Stonewall» Jackson defeated General Banks at Winchester, 25 May 1862, drove him across the Potomac, and then retreated up the Shenandoah Valley, slipping between the converging forces of General Frémont and McDowell near Strasburg on the 31st. Frémont pursued by the Valley road, and General Shields, commanding a division of McDowell's corps, endeavored to fall upon his flank and intercept him by moving up the Luray Valley. On the evening of 1 June Shields moved out of Front Royal, Col. S. S. Carroll leading, with some cavalry, infantry and four guns, to destroy the bridges over which Jackson might retreat to Stanardsville. But Jackson himself had destroyed the bridges by which his flank could be reached, and Shields halted his advance brigades at Conrad's Store and Columbia Bridge. On hearing that Jackson had passed through Harrisonburg in the direction of Port Republic, and that Frémont had reached Harrisonburg in close pursuit, Shields ordered Carroll's and Tyler's brigades forward to head off Jackson while Frémont pressed his rear. The orders to the two brigade commanders were to guard the river at Port Republic and cut the railroad at Waynesboro. Shields, with two brigades, remained at Luray to watch Longstreet, who was incorrectly reported moving into Luray Valley, by the gaps of the Blue Ridge, with 10,000 men. Carroll, with less than 1,000 infantry, 150 cavalry and Clark's regular battery of six guns, marched from Conrad's Store on the afternoon of 7 June, and halted in the night six miles from Port Republic, where his scouts brought information that Jackson's train was packed near the place, guarded by about 300 cavalry. Carroll, with his 150 cavalry and four guns, leaving his infantry to follow, started very early in the morning of the 8th, drove in the Confederate outposts and put two guns in position commanding both ends of the bridge over the South Fork of the Shenandoah River, and ordered the cavalry to charge and seize the bridge. The charge was made and the bridge seized, Jackson, whose headquarters were in the village, narrowly escaping across it, while some of his staff were captured. Carroll, with two guns, followed his cavalry to the bridge; some of the cavalry entered the village and attacked the wagon-train. By some misunderstanding the bridge was not burned as Shields says it was intended to be, and Jackson, the moment he crossed it, ordered batteries in position which opened on Carroll, and a regiment of infantry rushed down and over the bridge, driving him away and capturing one of his guns. Carroll retreated two miles down the river, with a loss of 39 men killed and wounded, the greater part of which was in the 7th Indiana, which came under artillery fire as it was moving to the support of the cavalry. Jackson moved Taliaferro's brigade into the village to hold the fords of South River, a branch of the South Fork of the Shenandoah, and placed Winder's brigade on the north side of the latter to observe Carroll and by artillery check any renewed advance. While all this was transpiring the battle of Cross Keys (q.v.) was going on, and Jackson, hearing the sounds of the engagement, rode to the field. At 2 P.M. Tyler came up with his brigade and joined Carroll, and as senior officer assumed command. He had about 3,000 men and 16 guns, and took position with his right on the South Fork of the Shenandoah and his left on commanding ground, on which was disposed the greater part of the artillery. Jackson, who had repulsed Frémont at Cross Keys, on the 8th, returned to Port Republic during the night, leaving Ewell, with a small force, to confront Frémont, and early in the morning of the 9th led Winder's brigade across the bridge and attacked Tyler's right, with the intention of turning it, but was repulsed. Winder, rallying a part of his brigade and reinforced by a regiment of Taylor's Louisiana brigade, made another effort and was again repulsed, with the loss of one of his guns and many men. Meanwhile some of Ewell's troops from Cross Keys came on the field and Taylor's Louisiana brigade was ordered to turn Tyler's left and take his guns. Taylor moved under cover of dense woods to a position on the flank of Clark's battery of six guns, from which support had been withdrawn, and charged it; but Clark, turning his guns upon him, repulsed him with shell and canister. The attempt was renewed on that flank, but Tyler's infantry was now supporting the guns, and the contest around and among them, at close quarters, was severe, but the Confederates were held in check. The fight had now raged more than four hours, Jackson had withdrawn all his forces from Frémont's front, crossed the bridge and destroyed it, and concentrated against Tyler, who saw that the time had come to retreat, and gave the order, Carroll having charge of the movement. The artillery and infantry on the right were withdrawn in good order, but on the left so many horses had been killed or disabled that but one gun was saved, the Confederates advancing and seizing five, as Tyler's men began the retreat, and turning them upon the retiring troops, throwing the rear of the column into some disorder. The Confederate infantry followed four miles, the cavalry until Shields came up with the rest of his division, when pursuit was checked and Shields continued the retreat to Conrad's Store. After the retreat Frémont appeared on the opposite side of the river, which he could not cross, and opened upon Jackson with his artillery. During the morning Jackson had put his trains in motion for Brown's Gap of the Blue Ridge, and after the battle he followed them. The Union loss was 67 killed, 393 wounded, and 558 missing; the Confederate loss, 816 killed, wounded and missing. Consult 'Official Records' (Vol. XII); Allan, 'Jackson's Valley Campaign'; The Century Company's 'Battles and Leaders of the Civil War' (Vol. II).

E. A. CARMAN.

PORT-ROYAL, pōrt-roi'ạl, a Cistercian convent in France, which played an important part in the Jansenist controversy (see JANSENISM). It was founded in 1204 by Mahaut de

Garlande, wife of Matthieu de Montmorency, was situated near Chevreuse in the Yvette Valley, at what is now called Les Hameaux, about 15 miles southwest of Paris, and was under the rule of Saint Bernard. The original name of the site was Porrais or Porrois; this was transformed first into Port-du-roi, then into Port-Royal. Port-Royal had declined from its original severity, when in 1609 the abbess Jacqueline-Marie-Angelique-Arnauld undertook its reform. The number of the nuns increased under her rule, and in 1625 amounted to 80. The building had become insufficient, and the situation was unhealthy. The mother of the abbess therefore presented to the nuns the house of Cluny, situated at the end of the Faubourg Saint Jacques in Paris. The old site was subsequently improved by drainage, and a new house built on higher ground. The two sections of the convent were now distinguished as Port-Royal des Champs and Port-Royal de Paris. About 1636 a group of eminent literary men of religious tendencies, mostly the relatives of the abbess, took up their residence at a house called Les Granges, near Port-Royal des Champs, where they devoted themselves to devotional exercises, manual and literary work, the education of youth, and the compilation of educational works. These were regarded as forming a joint community with the nuns of Port-Royal, among whom most of them had relatives, and who in most matters followed their counsels. Among them were Antoine Arnauld, Arnauld D'Andilly, le Maistre de Sacy and his two brothers, the first two being brothers, the last three nephews of the abbess; Nicole, and subsequently Pascal, whose sister Jacqueline was a nun of Port-Royal. These men founded here an educational institution, which flourished till 1660, and became a rival to the institutions of the Jesuits, and as they adopted the views of Jansenius, subsequently condemned by the pope, a quarrel ensued, in which the Port-Royalist nuns, siding with their male friends, became subject to the opposition of the Jesuits, which culminated in the ruin of their institution. Port-Royal de Paris had, in the meantime, been growing rapidly in wealth and influence. It was protected by many persons of high rank at the court, some of whom made it their last retreat and bequeathed their fortunes to it. It was under the direction of the Abbé de Saint Cyran (Duvergier de Hauranne), whose virulent Jansenism led, during the last days of Richelieu, to his imprisonment in Fort Saint Vincennes. During the wars of the Fronde the house in the country exercised a liberal hospitality. The history of the struggle in which the two convents of Port-Royal successively succumbed to their foes is too long to be dealt with here. It has been related in detail by Racine, the most distinguished pupil of the Port-Royalist seminary, in his 'Histoire de Port-Royal.' The most remarkable incident in it was the miracle alleged to have been wrought upon the person of the niece of Pascal, and firmly believed in by two such men as Pascal and Racine. The object of this miracle, wrought by means of a thorn from the crown of our Saviour, was to demonstrate the innocence of the nuns of Port-Royal, accused by their opponents of contempt of the holy sacrament. But this vindication was unavailing. In 1664 Port-Royal de Paris was occupied by the police. The nuns, save few who acceded to the terms of the court, and henceforth became declared enemies of their former associates, were imprisoned for some months and then sent to Port-Royal des Champs, which was put under military surveillance till 1669. In 1669 the two houses were permanently separated by royal authority. Port-Royal des Champs retained 80 nuns and two-thirds of the joint property, Port-Royal de Paris 10 nuns and one-third of the joint property, and was placed perpetually under the nomination of the king. The nuns of Port-Royal des Champs still persisted in refusing to sign the papal edict condemning the doctrines of Jansenius, and on 29 Oct. 1709 the convent was finally suppressed by order of Cardinal Noailles, in execution of a bull of Pope Clement XI. The nuns were dispersed in different convents, and their property given to Port-Royal de Paris. This convent continued in existence till the Revolution, when its house was converted into a prison, and subsequently (1814) became the Maternity Hospital. In 1825 some Jansenist descendants bought the site at Les Hameaux, on which they have erected a museum rich in Jansenist relics. The grounds have been restored as far as possible to their original appearances. (See ARNAULD; JANSENISM; PASCAL, BLAISE). Consult Gregoire, 'Les Ruines de Port Royal' (1809); Beard, Charles, 'Port Royal' (2 vols., London 1861); Cadet, Félix, 'Port Royal Education' (Eng. trans., New York 1898); Barnard, H. C., 'Little Schools of Port Royal' (Cambridge 1913); Clark, W. R., 'Pascal and the Port-Royalists' (New York 1902); Lowndes, M. E., 'The Nuns of Port-Royal as Seen in Their Own Narratives' (New York 1909); Racine, Jean, 'Histoire abrégée de Port-Royal' (Paris 1742; new ed. by E. Gazier. ib., 1908); Rea, Lilian, 'Enthusiasts of Port Royal' (New York 1912); Reuchlin, H., 'Geschichte von Port Royal' (2 vols., Hamburg 1839–44); Romanes, Ethel, 'The Story of Port Royal' (New York 1907); Ricard, Antoine, 'Les premiers Jansenistes et Port-Royal' (Paris 1883); Schimmelpenninck, M. A., 'Select Memoirs of Port Royal' (5th ed., Philadelphia 1853); Sainte-Beuve, C. A., 'Port Royal' (6 vols., Paris 1882).

PORT ROYAL, Jamaica, the principal naval station owned by the British in the Caribbean Sea. Port Royal, the city, which was destroyed by an earthquake in 1693, was near the site of the present naval station. The present Port Royal is at the entrance to Kingston Harbor. It is strongly fortified and has a barracks, arsenal and a hospital.

PORT ROYAL, S. C., village in Beaufort County, at the southern end of Port Royal Island, on the Port Royal and Augusta Railroad, 53 miles southwest of Charleston. Near here, a French Huguenot colony was established in 1664 by Ribault, which was taken by the Spaniards in 1665 and all the garrison killed. On 3 Feb. 1779, during the southern campaign of the Revolution, Major Gardiner, with 200 British soldiers, attempted to seize Port Royal Island, but was attacked and defeated by General Moultrie with about the same number of men, the British loss being serious, that of the Americans slight. In the Civil War the harbor of Port Royal was defended by two forts, Fort Walker and Fort Beauregard, built by the Confederates and garrisoned by a Confederate force under Drayton and Ripley. On 7 Nov. 1861 an attack was made on these fortifications by the Federals with a force of two frigates, three sloops and seven gunboats, commanded by S. F. Dupont (q.v.). This fleet opened fire on both forts at once, on entering the harbor, but later concentrated the attack on Fort Walker till that fort surrendered; Fort Beauregard was surrendered shortly afterward. Port Royal has an excellent harbor, and a large drydock, and has been the rendezvous of the North Atlantic Squadron. Pop. about 700. Consult Parkman, 'Pioneers of France in the New World' for an account of the Huguenot colony.

PORT ROYAL BAY, Battle of. As early as June 1861 the United States authorities, in order more effectually to maintain the blockade and to secure a military and naval base of operations on the southern Atlantic Coast, determined to seize a good port south of Cape Hatteras; and in August a naval and land expedition was ordered for the purpose. Capt. S. F. Dupont was ordered to organize the naval expedition, and Gen. Thomas W. Sherman to organize a force of 12,000 men to accompany it. It was agreed between Dupont and Sherman to seize Port Royal Bay, one of the finest harbors on the coast, 56 miles south of Charleston and 25 north of Savannah. The destination was kept a profound secret. The fleet of 16 war vessels and nearly 40 transports, carrying Sherman's 12,000 men with supplies, sailed from Hampton Roads on the morning of 29 October, and on the night of 1 November was struck by a furious storm off Hatteras and scattered. Four vessels and a few lives were lost, one war vessel was disabled and, with two transports, returned to Hampton Roads; but by the 6th the fleet had assembled off the entrance to Port Royal Bay, the gunboats, preceding, having driven into the harbor three Confederate vessels that had run out and opened fire upon them, and coming under a long cross-fire from two works commanding the entrance to the bay. It had been the intention to silence and take these works on the afternoon of the 6th but necessary arrangements were not perfected until too late in the day. The bay was defended by two earthworks and some shore batteries, one earthwork on each side of the entrance, Fort Walker, on Hilton Head, the south side, and Fort Beauregard, on Bay Point, Saint Phillips Island, on the north. These were strong and well-constructed works, mounting 42 heavy guns, 22 of which were in Fort Walker, and garrisoned by nearly 3,000 men, under Gen. T. F. Drayton. The distance between the two works was two and one-half miles. In addition to the landworks, there were three small Confederate gunboats of two guns each in the bay, under command of Com. Josiah Tatnall. The *Wabash*, the flagship of the fleet, carrying 46 guns, was to lead in the attack, followed by nine other vessels, a ship's length apart, and a flanking column of five gunboats was to move on the right. The fleet was to pass up the roads on the Bay Point side, delivering broadsides on Fort Walker until each vessel had reached a point two miles above the fort, when they were to turn and come down and again deliver their broadsides at Fort Walker and enfilade its two water-faces. Having completed the circuit, the line was to repeat the movement until the forts surrendered. At the same time the five flanking gunboats were to pass and attack Fort Beauregard and, on reaching the turning-point two miles above it, remain there and hold Tatnall's fleet in check, with special orders to see that it did not make a dash upon the transports. At 9 A.M. 7 November the fleet crossed the bar and advanced in a long well-ordered column to the attack, while the transports lay at anchor outside ready to land troops. Captain Dupont led the *Wabash* up the middle of the bay, receiving the first fire from both forts at 9.26 A.M., and replying to both, until two miles beyond them; then he turned to the left in a wide circle and led back past Fort Walker at 800 yards distance, opening upon it broadside after broadside. The rest of the column followed, each vessel in succession opening its guns, as it came within range and maintaining a rapid fire as it slowly drew past. The gun-fire from the fleet was a terrific continuous roar and was replied to by a well-maintained fire, notwithstanding the fact that hundreds of shells were dropping into the fort and almost burying its defenders, under the dirt thrown up. At the same time the flanking column of five gunboats steamed up the bay, nearer to Bay Point, and poured broadsides into Fort Beauregard and then, steering to the other side, advanced against Tatnall's fleet, driving it into Scull Creek and, taking position near the shore and flanking Fort Walker, opened upon it a destructive fire, to which it could not respond, as the one gun on that flank of the fort had been shattered by a round shot. After the main column had passed down the bay about two miles, it turned, at 11 A.M., and again passed in front of Fort Walker, at 300 yards closer range than before, and with a more terrific fire, part of which was against Fort Beauregard. As the manœuvre was repeated for the third time it was discovered that the Confederates were abandoning Fort Walker; its guns were silenced; a few shots were fired, to which there was no response; a small party was sent ashore, the Confederate flag hauled down, and the Union flag run up at 2.20 P.M. Before the close of the action the *Pocahontas*, Commander Percival Drayton, which had been delayed by injuries received in the storm, entered the bay and opened fire on the fort. Commander Drayton was a brother of the commanding officer of the Confederate forces. The Confederates had left in haste, leaving tents standing, and escaped across Scull Creek, being assisted by the boats of Tatnall's fleet. By nightfall the transports had come into the bay and landed Gen. H. G. Wright's brigade at Hilton Head. Fort Beauregard was abandoned about 5 P.M., after its commanding officer had spiked the guns and destroyed the greater part of the powder. It was occupied next morning by General Stevens' brigade. The battle was of great value to the Federal government in its moral and political effect, in addition to the fact that it gave the Union army one of the finest harbors on the Atlantic Coast, as a base for future operations for both the army and navy. The Union loss was 8 killed and 23 wounded; the Confederate loss, 11 killed, 48 wounded and 7 missing. Consult ‘War Records’ (Vol. VI); ‘Naval War Records’ (Vol. XII); Ammen, ‘The Atlantic Coast’; Maclay, ‘History of the United States Navy’ (Vol. II); ‘Battles and Leaders of the Civil War’ (Vol. I).

PORT ROYAL-DES-CHAMPS, pōr rwä-yäl dā shäṅ. See Port Royal.

PORT ROYAL FERRY, Engagement at. After the naval battle of Port Royal Bay (q.v.), 7 Nov. 1861, the navy explored the various sounds and creeks in the vicinity, capturing some abandoned guns. While the navy was thus employed the army had completed a very large and strongly intrenched camp on Hilton Head, surrounding Fort Walker, and on 11 December occupied Beaufort, some Confederate cavalry falling back across Coosaw River, taking to the farther side the ferry-boat and ropes and all other boats and covering the crossing by a blockhouse, which was soon destroyed by two adventurous soldiers who swam the river. By the end of December the Confederates had erected a strong field-work on the mainland opposite and commanding Port Royal Ferry, on the Coosaw, and they repulsed the efforts of the gunboats to dislodge them. The position was held by the 14th South Carolina regiment, four companies of the 12th South Carolina, about 45 cavalry and a section of Leake's battery, all under command of Col. James Jones. Obstructions had been placed in the Coosaw above and below the ferry to prevent the ascent of the gunboats, and a battery put in position opposite Seabrook's Point. A combined land and naval expedition was set on foot to take the position and clear the river. Gen. I. I. Stevens' brigade, reinforced by two regiments, in all 3,000 men, was to cross the Coosaw several miles below Port Royal Ferry, advance up the left bank of the river and take the work in rear, while two gunboats, an armed tug and four boats armed with howitzers, all under Commander C. R. P. Rodgers, were to enter the Coosaw by Beaufort River. A naval co-operating force was to move up Broad River and thence to the Coosaw to attack the battery opposite Seabrook's Point. On the night of 30 December a large number of flatboats were collected and sent up Beaufort River, and at 1 A.M. 1 Jan. 1862 the embarkation began and, passing up the Coosaw, the troops were landed during the morning. At 1.30 P.M. they moved for Port Royal Ferry, marching parallel with and close to the river, the gunboats and launches shelling the woods in advance of the skirmish-line. A mile had been marched when a concealed battery opened its fire on Stevens' column, but Stevens soon drove it and its infantry support from the field and, closely following, reached the fort which had been abandoned, upon the appearance of the gunboats, the enemy leaving one gun. Meanwhile the gunboats moving by way of Broad River had cleared the Coosaw, beyond the ferry. During the night the ferry was completely restored, the captured fort leveled to the ground, and next morning the troops crossed the ferry and marched back to Beaufort with the captured gun and a few prisoners. The result of the action was an abandonment of any future attempt to plant batteries on the Coosaw or the adjacent network of waters; and, being almost the first Union success since the defeat at Bull Run, it was considered of so much importance that the thanks of the government were given in general orders to General Stevens and his command for their victory at the battle of Port Royal Ferry. The Union loss was 3 killed and 14 wounded; the Confederate loss, 8 killed and 23 wounded. Consult ‘Official Records’ (Vol. VI); Ammen, ‘The Atlantic Coast’; Stevens, ‘Life of Gen. I. I. Stevens’ (Vol. II); ‘Battles and Leaders of the Civil War.’

PORT SAÏD, sä-ēd', Egypt, seaport at the Mediterranean end of the Suez Canal and capital city of the Egyptian department of the Isthmus. It lies in the easternmost part of an island between the Mediterranean and Lake Menzaleh, about 110 miles north-northeast of Cairo, in lat. 31° 16′ N. and long. 32° 19′ E. Its whole being is dependent on the canal and it was not founded until the canal was partly built. Hence its architecture is European, and many of the houses are wooden with sloped roofs. North of the city on the coast of the canal and of the Mediterranean is an electric light about 173 feet high and visible 20 miles out. Two great concrete moles 5,300 and 7,400 feet long reach out into the sea. The trade of the city is almost entirely transit. The city was named for Said Pasha, viceroy of Egypt 1854–63. A fountain and statue of Queen Victoria was built in 1898, and a colossal statue of De Lesseps, by Frémiet, has stood since 1900 at the entrance of the canal. Attempts by the Turks in the World War to capture the city and wreck the Suez Canal proved signal failures. The population of Port Said and Ismailia, including more than 10,000 Europeans, mostly French and Greek, numbered about 90,000 in 1917.

PORT OF SPAIN, Trinidad, city, capital of Trinidad (q.v.), one of the West Indies group, belonging to Great Britain. The city has a large safe harbor, steamer connections with all the principal ports of the Caribbean Sea and Gulf of Mexico, and with many South American ports; and railroad connection with San Fernandino, to the south, and with several other places on the island. The most of the products of the Orinoco region are shipped from Port of Spain. The city is well built and has many fine residences. It has the government buildings, botanical gardens and the Immaculate Conception College. It is a Roman Catholic archiepiscopal see. Pop. 60,000.

PORT TAMPA CITY, Fla., town, Hillsboro County, on Tampa Bay, and on the Atlantic Coast Line Railroad, eight miles south of Tampa. It was founded in 1889 and incorporated as a town in 1891. In the Spanish-American War, the United States troops were mobilized here for embarkation to Cuba. It is the port of Tampa (q.v.), has a large and excellent harbor and is connected with the West Indies, Mobile and other ports by steamer. It is in a fruit-growing and agricultural region for the products of which it is the shipping point. Pop. 1,343.

PORT TONNAGE. Some interesting facts are shown as to the relative rank in tonnage movement of the principal ports of the world, in a table prepared by the Bureau of Statistics of the Department of Commerce and Labor at Washington. The table is as follows:

PORT	Year	Entered tons	Cleared tons
New York	1910	13,042,818	12,541,903
Antwerp	1909	11,907,689	11,894,492
London	1909	11,605,698	8,622,316
Hongkong	1909	11,150,560	11,194,098
Hamburg	1909	11,061,041	11,247,191
Rotterdam	1909	9,217,493	8,902,570
Shanghai	1909	9,092,427	9,400,382
Liverpool	1909	7,747,904	6,593,094
Singapore	1908	6,994,980	6,948,225
Colombo	1909	6,593,591	6,587,028
Aden	1909	5,973,065	3,055,376
Cardiff	1909	5,771,476	8,888,756

Hongkong would show a much higher figure, but for the fact that Chinese junks engaged in the foreign trade are excluded from the estimate, the tonnage of these vessels entered in 1901 having been 1,126,931, and of those which cleared, 1,130,279. Singapore excludes native craft and vessels under 50 tons, excepting vessels engaged in trade between the Straits Settlements.

In this connection it is interesting to note that during the fiscal year 1 July 1917–30 June 1918, the net tonnage of vessels that entered the various ports of continental United States aggregated 45,455,937 tons, of which 19,283,530 tons represented American vessels; and the net tonnage of vessels that cleared the ports aggregated 46,069,482, of which 19,261,733 were American. It should also be noted that during this period the imports of merchandize into the United States aggregated in value $2,946,059,403, and the similar exports from the United States, $5,928,285,641 — the largest totals on record. And this when the world was aflame from the Teutonic torch.

In the previous fiscal year the tonnage entrances and clearances at United States customs districts aggregated 50,472,176 and 52,077,070 tons, respectively, as follows: Atlantic Coast, 24,010,685 and 25,047,868; Gulf Coast, 6,991,335 and 7,570,242; Mexican border, 65,670 and 64,396; Pacific Coast, 5,453,278 and 5,411,299; and Northern border, 13,951,208 and 13,983,265.

PORT TOWNSEND, Wash., city, county-seat of Jefferson County, on Port Townsend Bay, at the entrance to Puget Sound (q.v.), and on the Northern Pacific and the Port Townsend Southern railroads, about 70 miles north of Olympia. It has steamer connection with San Francisco, Alaska and many of the principal ports on the eastern coast of Asia. The harbor ranks with the largest in the world. The place was settled in 1851 and in 1860 was incorporated as a city. Port Townsend is on the west side of the bay, five miles by land and two and one-half miles by water from the city, and other government fortifications are located on Admiralty Head, Point Hudson, Point Partridge and Marrowstone Point. The government has established a marine hospital and a quarantine station. The city is included in the Puget Sound customs district, through which about $140,000,000 in trade passes annually.

The city is in an agricultural and lumbering region. In the vicinity are deposits of oil and valuable minerals. The chief industrial establishments are lumber and planing mills, a shipyard, machine shops, steam-boiler works, bottling works, herring pickling and curing works, salmon and sardine canneries, grain elevators and flour mills. The chief exports are grain, lumber, fish, oil, livestock, farm and dairy products and pig iron. The pig iron is from the Irondale furnaces. The principal public buildings are the government custom house, city hall, county courthouse, United States Marine Hospital, the quarantine station, a sanatorium and Saint John's Hospital. The educational institutions are a high school, public elementary schools, private business schools and a public library. The scenery around Port Townsend is beautiful, surrounded as it is by water and mountains. The government is administered under a charter of 1890, which provides for a mayor, who holds office one year, and a council. The administrative officials are appointed by the mayor or elected by the council. Pop. 4,181.

PORT WASHINGTON, Wis., city and county-seat of Ozaukee County, on Lake Michigan and on the Chicago and Northwestern Railroad, 25 miles north of Milwaukee. Its industries include the manufacture of woodenware, foundry products, internal-combustion engines, etc. Pop. 3,792.

PORT WINES. The name of port wines, or Oporto wines, is given, in commerce, to the produce of the vineyards of Portugal, the district in which they are produced being a rugged and mountainous tract that begins about 60 miles above Oporto, and extends for 30 or 40 miles with an extreme breadth of about 12 miles. Port is naturally a very rich and delicate wine, varying in color from a pale rose to a deep red. It owes its special character partly to the soil of the district where it is grown, partly to the climate, which is cold in winter and very hot in summer. The harvest lasts from the beginning of September to the middle of October. The wines for export are very much mixed and are strongly fortified with brandy, partly to make them sooner ready for export and partly to suit the taste of the foreign markets. The mixing of the various wines considerably reduces the variety of qualities of port exported, compared with those which are naturally produced. The English market has always been the principal market for port wine. English connoisseurs have tended more than anything else to spread its fame in other countries. The taste for this wine was introduced into England in the 17th century and English establishments were formed in Oporto to direct the purchase and shipping of the wines. These companies eventually united into a sort of corporation called the English Factory, which became completely master of the market. In the following century (1756) the Marquis of Pombal organized an association of producers to oppose this monopoly of buyers and the company then established imposed restrictions on the trade which were not finally abolished till 1853, a new company having latterly taken the place of the old. In recent times the vines have suffered rather severely both from the oidium and from the more serious plague of the phylloxera. See WINE and WINE MAKING.

PORTAELS, Jean François, zhŏṅ fräṅ-swä pōr-täls, Belgian painter: b. Vilvorde, near Brussels, 1 May 1818; d. Brussels, 8 Feb. 1895. He owed his early art training to Navez of Brussels and afterward proceeding to Paris became the pupil of Paul Delaroche, gaining the «Grand Prix» in 1842. After traveling in Syria, Egypt, Palestine, Greece and Turkey, he was appointed director of the academy in Ghent, an office he retained for three years. He then resumed his travels which included the whole of Europe in their range. He ended his days as director of the Brussels Academy. His works are faulty in composition and deficient in living characterization, but in spite of occasional insipidity they are pleasing and full of expression. Among them the most important are ‘The Journey of the Magi’; ‘Funeral Procession in the Desert of Suez’; ‘Jeptha's Daughter’; ‘The Daughter of Zion’; ‘The Flight into Egypt’; ‘Leah and Rachel’; ‘The Young Witch’; ‘The Simoon.’

PORTAGE, N. Y., town in Livingston County, on the Erie and Pennsylvania Railroads, 60 miles southeast of Buffalo. It is the distribution and marketing centre for a prosperous agricultural district and here also is Letchworth Park of 1,000 acres crossed by the Genesee River, which is crossed by a fine bridge. The falls of the river and the cañon at this point are very picturesque. The town contains a museum. The park is the gift to the State of William Pryor Letchworth. Pop. 1,273.

PORTAGE, Pa., borough of Cambria County, on the Pennsylvania Railroad, six miles southeast of Ebensburg. There are several coal mines nearby and coal-mining is the principal industry. Pop. 2,954.

PORTAGE, Wis., city, county-seat of Columbia County, on the government ship-canal between the Fox and Wisconsin rivers, and on the Chicago, Milwaukee and Saint Paul and the Minneapolis, Saint Paul and Sault Sainte Marie railroads, about 92 miles west by north of Milwaukee and 35 miles north of Madison, the State capital. It was settled in 1835, incorporated in 1837 and in 1854 was chartered as a city. It is in a productive agricultural and lumbering region and is the commercial and industrial centre for quite a large portion of Columbia County. The chief manufactures are flour, brick, hosiery, knitgoods and farm implements. The educational institutions are a high school, public and parish elementary schools and a public library. In the vicinity are the ruins of Fort Winnebago (1828). The government is according to the commission plan since 1912. The city owns the waterworks. Pop. 5,440.

PORTAGE GROUP, *in geology,* a portion of the Devonian series, so-called by the geologists of the New York State Survey because largely developed near the town of Portage, N. Y. The rocks of this period are chiefly sandstone and shale.

PORTAGE LA PRAIRIE, pôr'tāj lä prā'rĭ, Canada, a town in Manitoba, on the Canadian Pacific, Grand Trunk Pacific, Canadian Northern and Great Northern railway, 56 miles west of Winnipeg and 15 miles south of Lake Manitoba. It is an important railway centre and the receiving and distributing point for the fertile «Portage Plains,» one of the finest wheat-growing sections in the world. It has railway machine shops, a large flouring mill, grain elevators, a paper mill, brickworks, and is the seat of an Indian industrial school and the provincial home for incurables. Pop. 5,892.

PORTE, The, or **OTTOMAN PORTE.** See Sublime Porte.

PORTE CRAYON. See Strother, David Hunter.

PORTEOUS RIOT, so called from the lynching of Capt. John Porteous, commander of the city guard of Edinburgh, 7 Sept. 1736, was occasioned by various incidents connected with the trial and execution of Andrew Wilson, a smuggler, who with two companions had robbed the Kirkcaldy excise officer. The mob after the execution became disorderly and commenced throwing stones, whereupon Porteous ordered his command to fire into the crowd, with the result that seven people were killed and 20 wounded. Porteous, after trial, was condemned to death, but being reprieved, a mob broke into the jail and hanged him. The city was fined $4,500 for the benefit of the widow and the provost was imprisoned for a year and disqualified from holding any further official position. The Porteous Riot is one of the main features of Sir Walter Scott's ‘Heart of Midlothian.’

PORTER, Alexander, American jurist: b. Armagh, County Tyrone, Ireland, 1786; d. Attakapas, La., 3 Jan. 1844. He came to the United States in 1801, settled in Nashville, Tenn., studied law and was admitted to the bar in 1807. He established a law practice in Saint Martinsville, La., in 1810; was a member of the convention which framed the State constitution in 1811; in 1821 was appointed a judge of the Supreme Court of Louisiana. During his 12 years' occupation of that office he established a fixed system of jurisprudence to supersede the chaotic mixture of Spanish, French and civil law in use. Elected United States senator in 1833 he voted to censure President Jackson for removing the deposits from the United States Bank, opposed the abolition of slavery in the District of Columbia and the bill to compel specie payment for public lands, advocated the division of surplus revenue among the States and also the recognition of Texas' independence. He was re-elected to the Senate in 1843.

PORTER, Anna Maria, English novelist, sister of Jane Porter (q.v.): b. 1780; d. near Bristol, Gloucestershire, 21 Sept. 1832. Before she was 15 she published two volumes entitled ‘Artless Tales.’ The greater part of her life was spent with her mother and sister Jane in the neighborhood of London. She produced numerous novels, which enjoyed considerable popularity in their day. Among them are ‘Walsh Colville’ (1797); ‘The Lake of Killarney’ (1804); ‘The Hungarian Brothers’ (1807); ‘The Recluse of Norway’ (1814); ‘The Knight of Saint John’ (1817); ‘Rocke Blanche’ (1822); ‘Honor O'Hara’ (1826); ‘The Barony’ (1830). She also published ‘Tales of Pity’ and ‘Ballads, Romances and Other Poems.’ Nearly all her books were translated into French and several were republished in this country.

PORTER, Benjamin Curtis, American portrait painter: b. Melrose, Mass., 27 Aug. 1843; d. New York City, 2 April 1908. He early became a pupil of Dr. Rimmer and A. H. Bicknell in Boston, studied art in Paris and Vienna in 1872–78 and first devoted himself to figure painting, but later made portraits his specialty. In 1880 he became a member of the National Academy. His work showed harmonious coloring, and his portraiture was accurate and striking. Among his works are ‘Henry V and the Princess Kate’ (1868); ‘Cupid with the Butterflies’ (1874); ‘Portrait of Boy with Dog’ (1884), etc.

PORTER, Charles Talbot, American mechanical engineer: b. Auburn, N. Y., 1826; d. 1910. In 1845 he was graduated at Hamilton College; was admitted to the bar and practised law for many years before he adopted the career of engineer. He became a partner of John F. Allen and with him controlled the manufacture of the Porter-Allen engine. He was the first engineer to complete the resistances of the reciprocating type of engine and to evolve the high-speed stationary engine. He invented two successful steam-engine governors. His published works include ‘Mechanics and Faith, Spiritual Truths in Nature’ (1885) and ‘Engineering Reminiscences’ (1908).

PORTER, Charlotte, American author: b. Towanda, Pa., about 1853. In 1875 she was graduated at Wells College. In 1886–88 she edited ‘Shakespeareana’ and the *Ethical Record* from April to December 1888. With Helen A. Clarke she founded *Poet-Lore,* of which she is still editor; and with her also edited ‘Poems of Robert Browning’ (2 vols., 1896); ‘The Ring and the Book’ (1897); ‘Clever Tales’ (1897); ‘Robert Browning's Complete Poetical Works’ (12 vols., 1898); ‘Mrs. Browning's Complete Works’ (6 vols., 1900); ‘Pembroke Edition of Shakespeare’ (12 vols., 1903); ‘Poets' Parleys’ (1903). She is sole author of ‘Dramatic Motive in Browning's «Strafford»’ (1897); ‘Browning Study Programmes’ (1900); ‘Stage Version Browning's Return of the Druses’ (1903); ‘Maeterlinck's Monna Vanna’ (1904); ‘Shakespeare Studies — Macbeth’ (1902); ‘The Tragedies’ (1911); ‘The Comedies’ (1912); ‘The Histories’ (1913); ‘Poetic Translation of D'Annunzio's Daughter of Jorio’ (1907); ‘Lips of Music,’ poems (1910); ‘Revels of Father Christmas and the Bishop’ (1917), etc., and contributions to periodicals.

PORTER, David, American naval officer: b. Boston, 1 Feb. 1780; d. Pera, near Constantinople, Turkey, 3 March 1843. He made voyages in the West Indian merchant service, was twice impressed by the British, but escaped, and in 1798 entered the United States navy as a midshipman. He was on board the *Constitution* in the fight with *L'Insurgente* in 1799, and served as a lieutenant in the war with Tripoli. Captured with the *Philadelphia,* he remained in imprisonment until the peace. In the War of 1812, he fought with distinction, capturing many English merchantmen, and seriously crippling Great Britain's whale-shipping in the Pacific. His vessel, the *Essex,* was blockaded in 1813 in Valparaiso Harbor by two English vessels, which he offered to fight either singly or together. This offer having been refused, he attempted to make a dash for the open sea, but his ship was severely damaged by a squall, and he put back, anchoring a half mile off the shore, and three miles from the town. There the English, regardless of neutrality laws, attacked him, and after a struggle of two and a half hours, one of the fiercest in naval history, compelled him to surrender. He described the situation in a communication to the Secretary of the Navy by saying, «We have been unfortunate, but not disgraced,» and upon his return he was voted the thanks of Congress and several State legislatures, and received with much distinction. He was sent in 1824, being then a commodore, to operate against pirates in the West Indies. An officer sent by him to make an investigation at Fajardo, Porto Rico, was seized and imprisoned. Porter compelled the Spanish authorities to apologize for the act; was deemed to have exceeded his authority; and was suspended for six months by court-martial. On 18 Aug. 1826 he resigned his commission, and became rear-admiral in the Mexican service. From this, too, he resigned in 1829; and later was consul-general to the Barbary states and chargé d'affaires at Constantinople. Among his writings are ‘Journal of a Cruise Made to the Pacifick Ocean’ (1815), and ‘Constantinople and its Environs’ (1835). Consult ‘Trial of Commodore David Porter before a Court-Martial’ (1825); Porter, D. D., ‘Life of Commodore David Porter’ (1875).

PORTER, David Dixon, American naval officer: b. Chester, Pa., 8 June 1813; d. Washington, D. C., 13 Feb. 1891. He was son of David Porter (q.v.). In 1826 he entered the service of the Mexican navy as midshipman, and while serving on board a vessel employed in damaging Spanish commerce was captured and for a time held prisoner in the Spanish guardship at Havana. Not long after his release, he was made midshipman in the United States navy, and until 1835 was on duty on the European station. In the Mexican War he distinguished himself as a lieutenant, and later as commander of the *Spitfire.* After the war he commanded passenger steamers during an extended furlough. At the beginning of the Civil War he was made commander of the *Powhatan* for the relief of Fort Pickens. On 22 April 1861 he was made commander, soon afterward was placed in charge of the mortar fleet, in March 1862 joined Farragut, and on 18–24 April exploded 20,000 bombs in the Confederate forts Jackson and Saint Philip, below New Orleans. Farragut's fleet was thereby enabled to pass them and capture New Orleans; and the forts finally surrendered on 28 April. At Vicksburg, also, Porter by his remarkably effective bombardment of the forts enabled the fleet to pass safely. He was ordered in September 1862 to command the Mississippi squadron as acting rear-admiral. With an improvised navy-yard at Mound City, he quickly increased his squadron to 125 vessels, and in January 1863 aided Sherman in the capture of Arkansas Post. Not long afterward he ran the Vicksburg batteries, captured the enemy's fortifications at Grand Gulf, communicated with Grant, and then coöperated with that general in the well-known siege of Vicksburg. On 4 July 1863 the city fell. Porter's commission as rear-admiral bore that date; he also received the thanks of Congress. He then aided Banks (1864) in the Red River expedition, and only with difficulty rescued his vessels. He was placed in command of the North Atlantic blockading squadron in 1864; and with Gen. A. H. Terry co-operated in the capture of Fort Fisher 15 Jan. 1865. After the war he was superintendent of the United States Naval Academy in 1865–69, and did much to improve it. He was promoted vice-general in 1866 and admiral in 1870. He wrote a 'Life of Commodore David Porter' (1875); a romance 'Allan Dare and Robert le Diable' (1885); 'Incidents and Anecdotes of the Civil War' (1885); 'Harry Marline' (1886); 'History of the Navy in the War of the Rebellion' (1887), and other works. Consult Chesney, 'Essays in Military Biography' (1874); Soley, 'Admiral Porter' (1903).

PORTER, Fitz-John, American soldier, cousin of David Dixon Porter: b. Portsmouth, N. H., 13 June 1822; d. Morristown, N. J., 21 May 1901. He was graduated from the United States Military Academy in 1845, was assigned to the 4th artillery, served in the war with Mexico, and was brevetted successively captain for services at Molino del Rey and major for similar services at Chapultepec. After the war he was on garrison duty until 1849, and then was made assistant instructor of artillery at West Point, where in 1854–55 he was instructor of artillery and cavalry. Appointed assistant adjutant-general in 1856, he served under Gen. A. S. Johnston (q.v.) in the Utah expedition of 1857–60. In 1860 he was made assistant inspector-general, with headquarters at New York; and in this post, during the Baltimore riots, he superintended the defense of the railway between Harrisburg and Baltimore. He became colonel of the 15th infantry, a newly-organized regiment, on 14 May 1861, and on 17 May brigadier-general of volunteers. After having been for a time on duty in Washington, he participated in the Peninsular Campaign (1862) in Virginia, and after the capture of Yorktown, in the siege of which he had fought (5 April–4 May), was for a brief while its governor. He was then made commander of the Fifth corps, which he led at Mechanicsville (26 June 1862) and Gaines' Mills (27 June). He was in command of the left flank, the centre of the conflict, at Malvern Hill (1 July 1862); and for his conduct at the battle of Chickahominy was brevetted brigadier-general, United States army. On 4 July 1862 he was made major-general of volunteers. While he was temporarily attached to Pope's Army of Virginia, the battle of Manassas or the second Bull Run occurred (29–30 Aug. 1862). On the first day his corps was ordered to advance, but found itself unable to do so; on the afternoon of the second day, however, it was in action, and by its stubborn bravery saved the defeat from being a complete rout. Pope was greatly dejected by the reverse, which he attributed largely to Porter's failure to execute orders. He made a complaint in his report but preferred no charges. Porter was in the defenses of Washington 2–13 September, then commanded the Fifth corps, Army of the Potomac, September–November, fought at Antietam (17 September), and afterward in the skirmish at Shepardstown (19 September). On 27 Nov. 1862 he was arraigned before a court-martial at Washington, charged with disobeying orders at the second Bull Run. On 21 Jan. 1863 he was cashiered, and, for violation of the 9th and 25th articles of war, was "forever disqualified from holding any office of trust or profit under the government of the United States." This sentence for years remained unaltered. Its justice was much debated. Numerous appeals were made for a reopening of the case, and Porter himself several times petitioned for a reversal of the judgment. Grant, while President, declined to reopen the case; but after his second term, upon an examination of all the testimony, published in an article entitled 'An Undeserved Stigma' (December 1882) his conclusions to the effect that Porter was by the evidence vindicated of the charges against him. Under President Hayes a military board acquitted Porter of all fault save unwise criticism of his superior. On 4 May 1882 President Arthur remitted the sentence so far as disability to hold office under government was concerned but a bill for Porter's relief failed to pass. A subsequent bill passed the 48th Congress, but was vetoed by Arthur on a technicality. A third bill, however, passed, and was signed by President Cleveland; and by the act of Congress of 1 July 1886 Porter was made colonel of infantry 5 Aug. 1886 to rank from 14 May 1861. On 7 Aug. 1886 he was placed on the retired list. Subsequent to 1863, Porter was superintendent of certain mining operations in Colorado in 1864–65; a merchant in New York 1865–71; superintendent of the erection of the New Jersey State asylum for the insane at Morristown; commissioner of public works, New York, 1875–76; assistant receiver of the Central Railroad of New Jersey, 1877–82; police commissioner, New York, 1884–88; fire commissioner, 1888–89; and cashier of the post-office, 1893–97. An offer, received in 1869, from the Khedive, to command the Egyptian forces with major-general's rank, was declined by Porter. Among the best statements of the case for and against Porter may be respectively mentioned, besides the article by Grant above cited (Vol. 135, *North American Review*), Lord, 'A Summary of the Case' (1883), and Cox, 'The 2d Battle of Bull Run as Connected with the Fitz-John Porter Case' (1882). See also POPE, JOHN.

PORTER, Gene Stratton, American author, ornithologist and illustrator: b. Wabash County, Ind., 1868. She received a private education and in 1886 was married to Charles Darwin Porter. For two years she was editor of the camera department of *Recreation* and two years on the natural history staff of *Outing*. Subsequently she was for four years specialist in natural history photography on the *Photographic Times Annual Almanac*. Mrs. Porter is the author of many entertaining and deservedly popular works including 'The Song of the Cardinal' (1902); 'Freckles' (1904); 'What I Have Done with Birds' (1907); 'At the foot of the Rainbow' (1908); 'A Girl of the Limberlost' (1909); 'Birds of the Bible' (1909); 'Music of the Wild' (1910); 'The Harvester' (1911); 'Moths of the Limberlost' (1912); 'Laddie' (1913); 'Michael O'Halloran' (1915); 'Morning Face' (1916); 'Friends in Feathers' (1917).

PORTER, Horace, American diplomat: b. Huntington, Pa., 15 April 1837. He studied at Harvard and was graduated from West Point in 1860; served for a short time as instructor there and at the outbreak of the Civil War was assigned to duty in the Department of the East. He commanded the siege batteries at Fort Pulaski and was brevetted captain for his gallantry. After the battle of Antietam he was transferred to the Army of the Ohio and later to that of the Cumberland. He was engaged at Chattanooga, Chickamauga, the battle of the Wilderness and New Market Heights, and as aide-de-camp on the staff of General Grant witnessed the surrender at Appomattox. In 1865 he was brevetted brigadier-general for his services throughout the war. He was assistant to Grant when that general was Secretary of War for a few months in 1867 and upon Grant's election to the Presidency Porter became his private secretary. In 1873 he resigned from the army. After the close of Grant's second term as President, Porter entered upon a business career in which he was eminently successful, became noted as an author and lecturer, and through his efforts the Grant Monument was completed. In 1897 he was appointed by President McKinley, United States Ambassador to France, which position he filled with tact and ability till 1905. He succeeded in finding the burial place of John Paul Jones, the American naval hero, and recovered the body, later sending it to the United States for burial in Annapolis. He was awarded the thanks of Congress and the privilege of the floor of each House for life, and was a delegate to The Hague Peace Conference of 1907. He wrote 'West Point Life' (1866); 'Campaigning with Grant' (1897).

PORTER, James, American Methodist Episcopal clergyman: b. Middleboro, Mass., 1808; d. 1888. In 1830 he became a member of the New England Conference and in 1856 became an agent of the Methodist Book Concern, and was reappointed in 1860 and 1864. From 1868 to 1882 Mr. Porter was secretary of the National Temperance Society; in 1852-55 was an overseer of Harvard University and in 1855-71 was trustee of Wesleyan University. He was the author of several works on religious topics.

PORTER, James Davis, American politician: b. Paris, Tenn., 7 Dec. 1828; d. Paris, Tenn., 18 May 1912. He was graduated from the University of Nashville in 1846; admitted to the bar in 1850; and sat in the Tennessee legislature, 1859-61. He served in the Confederate army during the Civil War, and was adjutant-general on the staff of Major-General Cheatham. In 1870-74 he served as judge of the 12th judicial circuit and in 1874-78 was governor of Tennessee. He was United States Assistant Secretary of State in 1885-89 and Minister to Chile in 1893-97. He wrote 'The Confederate Military History of Tennessee.'

PORTER, Jane, English novelist: b. Durham, England, 1776; d. Bristol, Gloucestershire, 24 May 1850. She was a sister of Anna M. and Sir Robert Ker Porter (qq.v.) and was brought up at Edinburgh and in London. She became immediately famous in 1803 by her historical romance, 'Thaddeus of Warsaw,' and 'The Scottish Chiefs' (1810) was even more successful despite its high-flown sentiment and stilted characterization. Other works of hers were 'The Pastor's Fireside' (1815); 'Duke Christian of Luneburg' (1824); 'Tales Round a Winter's Hearth' with Anna M. Porter (q.v.) (1824); 'The Field of Forty Footsteps' (1828), and 'Sir Edward Seaward's Narrative of his Shipwreck and Consequent Discovery of Certain Islands in the Caribbean Sea' (1831), a praiseworthy fiction, edited.

PORTER, Jermain Gildersleeve, astronomer: b. Buffalo, N. Y., 8 Jan. 1852. He was graduated from Hamilton College, Clinton, N. Y., in 1873 and studied at the University of Berlin. He was appointed to the United States Coast and Geodetic Survey in 1878 and since 1884 has been director of the Cincinnati Observatory and professor of astronomy at the University of Cincinnati. In 1894 he received the *Astronomical Journal* Comet Prize. His principal investigations have been on the motions of the stars and the variation of latitude. He published 'Our Celestial Home' (1888); 'The Stars in Song and Legend' (1901); also many catalogues of stars and nebulæ, and memoirs on various astronomical subjects.

PORTER, Noah, American educator: b. Farmington, Conn., 14 Dec. 1811; d. New Haven, Conn., 4 March 1892. Graduated from Yale in 1831, he was a tutor and student of theology there in 1833-35, was pastor of Congregational churches at New Milford, Conn., 1836-43, and Springfield, Mass., 1843-46. In 1846 he was made professor of moral philosophy and metaphysics at Yale, and from 1871 until his resignation in 1886 was president of that institution. His administration was a distinguished one. During it the curriculum was broadened by the introduction of new elective subjects, although Porter never favored the development of the elective system attempted at Harvard and supported the classic for the leading place in a scheme of liberal training. The material progress was also of note, large additions being made to the buildings and funds. Porter was also known as the editor of revised editions of Webster's 'Unabridged Dictionary.' He ranked among the foremost American metaphysicians of his time. Among his writings are 'Historical Discourse on Farmington' (1841); 'The Educational Systems of the Puritans and Jesuits Compared' (1851); 'The Human Intellect' (1868; and many subsequent eds.); 'Books and Reading' (1870); 'American Colleges and the American Public' (1871); 'Science of Nature *vs.* the Science of Man' (1871), a review of the philosophy of Spencer; 'Elements of Intellectual Science' (1871); 'Evangeline; the Place, the Story and the Poem' (1882); 'Science and Sentiment' (1882) 'The Elements of Moral Science' (1885); a 'Life of Bishop Berkeley' (1885) and 'Kant's Ethics: A Critical Exposition' (1886).

PORTER, Peter Buel, American soldier: b. Salisbury, Conn., 14 Aug. 1773; d. Niagara Falls, N. Y., 20 March 1844. He was graduated at Yale College in 1791, studied at the Litchfield Law School, and in 1795 began practice at Canandaigua, N. Y. In 1808 he was chosen a representative in Congress, where as chairman of the Committee on Foreign Relations he prepared and introduced the celebrated report of December 1811, recommending war against Great Britain. As soon as hostilities had been declared he resigned his seat in Congress, was appointed quartermaster-general of New York and took command of a body of Pennsylvania and New York volunteers and Indians of the Six Nations. Black Rock, where General Porter resided, having fallen into the hands of the British in June 1813, and his own house, from which he had barely time to escape, being their headquarters, he rallied a force by which they were expelled and their commander mortally wounded. In July 1814 he joined Brown's invading army with a brigade of 3,500 volunteers and Indians and distinguished himself at Chippewa and Lundy's Lane, and the siege of Fort Erie. He declined President Madison's appointment as commander-in-chief of the army in 1815, and served again in Congress for a few months. Porter was one of the earliest projectors of the Erie Canal, and was named, with Morris and Clinton, on the first board of commissioners to explore a route for it. In 1816 he was appointed commissioner under the Treaty of Ghent for determining the northwestern boundary. In May 1828 he was appointed Secretary of War by President Adams.

PORTER, Pleasant, Creek Indian leader: b. near Clarksville, in the Creek Nation, 26 Sept. 1840; d. Vinita, 3 Sept. 1907. His paternal grandfather, a native of Pennsylvania, was a captain in the United States army at the time of the Creek War and showed such consideration for the defeated Muskogees that they formally adopted him as a member of the tribe. Years later, Pleasant Porter's father, Benjamin E. Porter, settled in the Indian Territory, where he married the daughter of a prominent chief, Tah-to-pee Tust-e-nuk-kee, and became a planter. Pleasant Porter's early life was simple and uneventful. He was educated at the Presbyterian mission school at Tallahassee. At the outbreak of the Civil War he entered the Confederate service as a private soldier in one of the Creek Indian regiments. He saw much active service and was promoted through the non-commissioned grades to the rank of a first lieutenant. The end of the war found him, like most of his fellow-tribesmen, penniless. He then began the life of a farmer. His first official position in civil life was that of superintendent of schools in the Creek Nation, in which capacity he reorganized the tribal public school system, which had ceased to exist during the war. His ability becoming recognized, his services were soon in demand as a representative of his people in Washington. As the commander of the Creek National forces during the intratribal insurrection known as the Spiechee War, in 1882, he displayed not only courage but also good judgment and tact as well. During his later years he occupied the position of principal chief of the Creek Nation. In 1905 he was chosen as president of the Sequoyah Constitutional Convention, which gathered at Muskogee to frame the organic law for a commonwealth to be composed of the tribal domains of the five civilized tribes.

PORTER, Sir Robert Ker, English artist, brother of Jane and Anna Maria Porter (qq.v.): b. Durham, 1775; d. Saint Petersburg, Russia, 4 May 1842. He studied at the Royal Academy in London, and became famous for his battle pieces. In 1804 he was appointed historical painter to the czar of Russia. In 1808 he served under Sir John Moore in Spain, and in 1811 returned to Russia, where he married the Princess Sherbatoff. He was knighted in 1817, and from then until 1820 was engaged in antiquarian studies in Asia. In 1826–41 he was British consul at Venezuela. Of his paintings the most notable were 'The Storming of Seringapatam' (1800, destroyed by fire); 'The Siege of Acre'; 'Agincourt'; 'Peter the Great Planning the Port of Cronstadt and Saint Petersburg'; 'Christ at the Last Supper Blessing the Cup,' etc. He wrote 'Travelling Sketches in Russia and Sweden' (1808); 'Letters from Portugal and Spain' (1809); 'Narrative of the Late Campaign in Russia' (1813); 'Travels in Georgia, Persia, Armenia and Ancient Babylonia' (1821–22), etc.

PORTER, Robert Percival, American journalist: b. Norwich, England, 30 June 1852; d. 28 Feb. 1917. In his youth he emigrated to the United States and in 1872 was engaged on the staff of the Chicago *Inter-Ocean*. He specialized in economics and statistics; prepared census reports of the 10th census, and was appointed member of the Tariff Commission in 1882. On behalf of the *Tribune* of New York and the *Press* of Philadelphia he studied industrial and housing conditions in Europe. With Frank Hatton he founded the New York *Press* in 1887 and in 1890–94 was superintendent of the 11th census. He became a member of the staff of the London *Times* in 1904, and subsequently investigated social and industrial conditions in Cuba, Porto Rico and Japan. His published works are 'The West in 1880' (1882); 'Breadwinners Abroad' (1885); 'Free Trade Folly' (1886); 'Commerce and Industry of Japan' (1896); 'Life of William McKinley' (1896); 'Industrial Cuba' (1899); 'Lectures and Addresses on Municipal Ownership' (1903); 'Dangers of Municipal Ownership' (1907); 'The Full Recognition of Japan' (1911).

PORTER, Thomas Conrad, American botanist: b. Alexandria, Pa., 1822; d. 1901. In 1840 he was graduated at Lafayette College and three years later at the Princeton Theological Seminary. After five years of preaching he became professor of natural science in Marshall College (later Franklin and Marshall). He removed to Lafayette College in 1866 as professor of botany. In 1897 he resigned his professorial duties and became curator of the botanical collection of the college and dean of the Pardee school. His published works are 'Sketch of the Flora of Pennsylvania' (1872); 'Sketch of the Botany of the United States' (1873); 'Synoptical Flora of Colorado,' with J. M. Coulter (1874); 'The Carices of Pennsylvania' (1887); 'The Grasses of Pennsylvania' (1893).

PORTER, William David, American naval officer: b. New Orleans, La., 1809; d. 1864. In 1823 he entered the United States navy as midshipman; was gazetted lieutenant in 1833; retired in 1855, but restored to active service in 1859 with rank of commander. He was actively engaged during the war with Mexico in the '40's and organized the Lighthouse Service. When the Civil War broke out Porter was in command of the ironclad *Essex*, in the Mississippi, took part in the taking of forts Donelson and Henry and effected the passage of the river from Cairo to New Orleans through the fire of several Confederate batteries. On his second engagement with the ram *Arkansas* of the Confederate navy on 6 Aug. 1862, he sank her and sometime afterward bombarded the batteries at Natchez, Port Hudson and Vicksburg. On 16 July 1862 he was made commodore.

PORTER, William Sydney, American short-story writer, well known under the nom-de-plume of "O. Henry": b. Greensboro, N. C., 1862; d. 5 June 1910. He received an academic education in Texas, in which State he spent some time on a cattle ranch before beginning his journalistic career as reporter on the Houston *Post.* Shortly afterward he purchased *Brann's Iconoclast,* which he converted into a 10-page fiction weekly, and for which he furnished himself most of the copy. He renamed it the *Rolling Stone,* but soon abandoned the venture and undertook a journey to Central America. This trip was in after years of great use to him as a mine from which to draw some of his best tales. He set about raising bananas on a large scale and the venture proving unsuccessful he returned to Texas and sought employment as a druggist's clerk. Soon afterward he removed to New Orleans and there his literary work began in earnest. His stories were sent all over the country, but he remained in comparative obscurity until his removal to New York in 1901. Within a few years he became one of the most popular short-story writers in America. His 'Heart of the West' (1907) and 'Roads of Destiny' deal with Western life as he knew it, and his 'Cabbages and Kings' deals with life and incidents in Central America. His fame, however, rests on his stories of New York life in its many phases, from the palatial mansion of the millionaire to the homeless wayfarer and tramp of the slums. His stories are marked by a freshness of style and by keen penetration and characterization, albeit deficient in psychological insight and abounding in slang. The short stories have appeared in the following collections: 'Cabbages and Kings' (1905); 'The Four Million' (1906); 'The Trimmed Lamp' (1907); 'The Gentle Grafter' (1908); 'The Voice of the City' (1908); 'Options' (1909); 'Whirligigs' (1910); 'The Two Women' (1910); 'Strictly Business' (1910); 'Sixes and Sevens' (1911); 'Rolling Stones' (1912). A complete edition of his works was published at Garden City (1912).

PORTERANTHUS, an erect, perennial, medicinal plant of the rose family, growing in woodlands from two to four feet in height and bearing five-petaled white or pinkish flowers in May to July. Two varieties are known: *P. trifoliatus,* found in the area from New York and Lower Canada southward as far as Georgia and westward as far as Missouri; and *P. stipulatus,* found from western New York southward to Louisiana and westward as far as Oklahoma. The latter variety is smaller than the former and has five-parted leaves instead of three-parted leaves as in the former. The plant is popularly known by several names: False Ipecac, American Ipecac, Bowman's Root and Indian Physic.

PORTERSVILLE, Cal., city in Tulare County, on the Southern Pacific Railroad, 30 miles south of Visalia. The city is situated in the citrus-fruit region, which produces also great quantities of olives, deciduous fruits, berries, etc. Cattle-raising is also an important industry. The warehousing and shipping of these gives employment to a great number of Portersville citizens. In addition, there are marble and granite works, canneries, creameries, cement works and lumber yards, a public library, high school, recreation parks, etc. The water-supply system is the property of the municipality. Pop. 2,696.

PORTLAND, Conn., town of Middlesex County, situated on the Connecticut River, directly opposite Middletown, on the New York, New Haven and Hartford Railroad. It has manufactories of engine parts and there are brownstone quarries. Pop. 3,425.

PORTLAND, Ind., city, county-seat of Jay County, on the Salamonie River, Grand Rapids and Indiana, Lake Erie and Western and Chicago, Bluffton and Cincinnati railroads, and the Muncie and Portland Traction line, about 45 miles southeast of Fort Wayne. It is in the midst of a productive agricultural region. The chief manufacturing establishments are woodworking plants, automobile parts, flour mills, clay and tile works, machine shops, cooperage and creameries. The manufacturing investment aggregates $850,000 and value of products $1,400,000. The educational institutions are five public schools and a free public library. There is a public hospital. The city owns and operates an electric-light plant and waterworks. There is a supply of natural gas. The five banks have annual clearings over $16,000,000. The city is especially noted for large mercantile trade. There are six miles of brick streets. Pop. 6,300.

PORTLAND, Me., the largest city in the State, an important seaport and county-seat of Cumberland County, is situated on Casco Bay, 106 miles northeast of Boston, with which it is connected by the Boston and Maine Railroad. The Maine Central and Grand Trunk railways connect it with the eastern part of the State and the British provinces. It has direct steamship connections with Boston, New York and other Atlantic Coast ports, and steamship lines to Europe. The government defense works here, recently enlarged, include Fort Preble, Fort Williams on Portland Head, Fort Levett on Cushing's Island and Fort McKinley on Great Diamond Island. Forts Scammel and Gorges, formerly strongly equipped, command the entrance to the harbor.

Topography.— The city proper has an area of 17½ square miles and is well laid out, with beautiful shade trees lining its streets and avenues. The site is one of great natural beauty, rising on a peninsula extending into Casco Bay, in view of many small islands, which have become popular summer resorts for Portland residents. In the vicinity are many other resorts and watering places, popular with people from all parts of the Union and an increasing number of tourists from foreign countries. The drives around the two hills at the extremities of the peninsula are not surpassed in beauty by any in the United States. The city slopes from the water front to two heights, forming a natural amphitheatre, giving the city a picturesque appearance from the sea. The harbor is protected by a massive breakwater.

Park System.— The extensive public park system of Portland includes over 115 acres and embraces the Eastern and Western Promenades, on the latter of which is a fine statue of Thomas B. Reed, Lincoln Park, Fort Sumner and Fort Allen parks, Deering's Oaks and Monument square, in the latter of which stands an elaborate memorial, the work of Franklin Simmons, a son of Maine, to the Maine soldiers who were killed in the Civil War. These parks will soon be connected by a boulevard extending around Back Bay, forming a driveway of about three miles and affording extensive views of sea and mountains.

Public Buildings.—Among the prominent buildings are the United States Courthouse, the City Hall, the Custom House, Post Office, Mechanics' Hall, United States Marine Hospital, the Public Library, containing over 80,000 volumes, and the library of the Maine Historical Society of 14,000 volumes; the Portland Society of Natural History; the Maine Eye and Ear Infirmary, the New City Building, the Portland Society of Art, the Cumberland Club, the Trelawny building, the Fidelity building, Portland School for the Deaf, Old Men's Home, Home for Aged Women, Saint Elizabeth's Academy, Female Orphan Asylum, Episcopal and Roman Catholic cathedrals and several noted colonial mansions, including the Longfellow House and Deering Mansion.

Government.— The city is governed under a charter granted in 1863, subsequently amended, and later acts, by a mayor elected annually, a bicameral council, consisting of 36 members, three councilmen and one alderman from each ward, and city officials, most of them elected by the people. The city marshal, commissioner of public works and members of the board of health are appointed by the mayor. The members of the board of education are elected by popular vote. The city has waterworks, electric lighting system and electric street railways.

Schools.— The graded school system of Portland is excellent and managed by a school board of 12 members, including three women, who are elected as members at large. The mayor is chairman ex-officio of the board. There are two high schools, 19 grammar, 31 primary, nine kindergarten, besides a manual training school. The cost for maintaining the schools was for 1915 $303,822.35. The Roman Catholics maintain four parochial schools.

Fire Department.— There is an efficient fire department, under the charge of a chief and four assistants. The department is managed by a committee of the city government; the cost for the year 1915 was $157,037.93.

Churches.— Portland has 52 churches, among which are three Baptist, three Roman Catholic, 14 Congregational, four Episcopal, three Lutheran, 15 Methodist, one Presbyterian, two Second Advent, two Unitarian and five Universalist churches. No city of its size has more benevolent societies.

Courts and Police Department.— There are United States courts, circuit and district; supreme-judicial; superior; probate and municipal courts. The police department is under the charge of a chief and two deputies. The mayor is at the head of the deparment. The cost of maintenance for 1915, including pensions ($5,007.93), was $129,760.14.

Manufactures.— Portland has 271 manufacturing establishments, of which by last public report the output was valued at $11,950,000. The industries include boot and shoe factories, rolling-mills, foundries, machine shops, locomotive works, engine and boiler works, petroleum refineries, match factory, chemical works, carriage and sleigh factories, manufactories of stoneware, jewelry, edge tools, varnishes, soap, meat-packing establishments, cooperage shops, lumber mills, etc. The capital invested in these industries, according to last census, was $9,597,000. Shipbuilding is still carried on, though of less importance, relatively, than in former years. Fishing and the shellfish industry are extensively pursued. The assessed property valuation (1915) was $71,843,235. Net public debt, $408,937.71. Tax rate (per $100), $2.28.

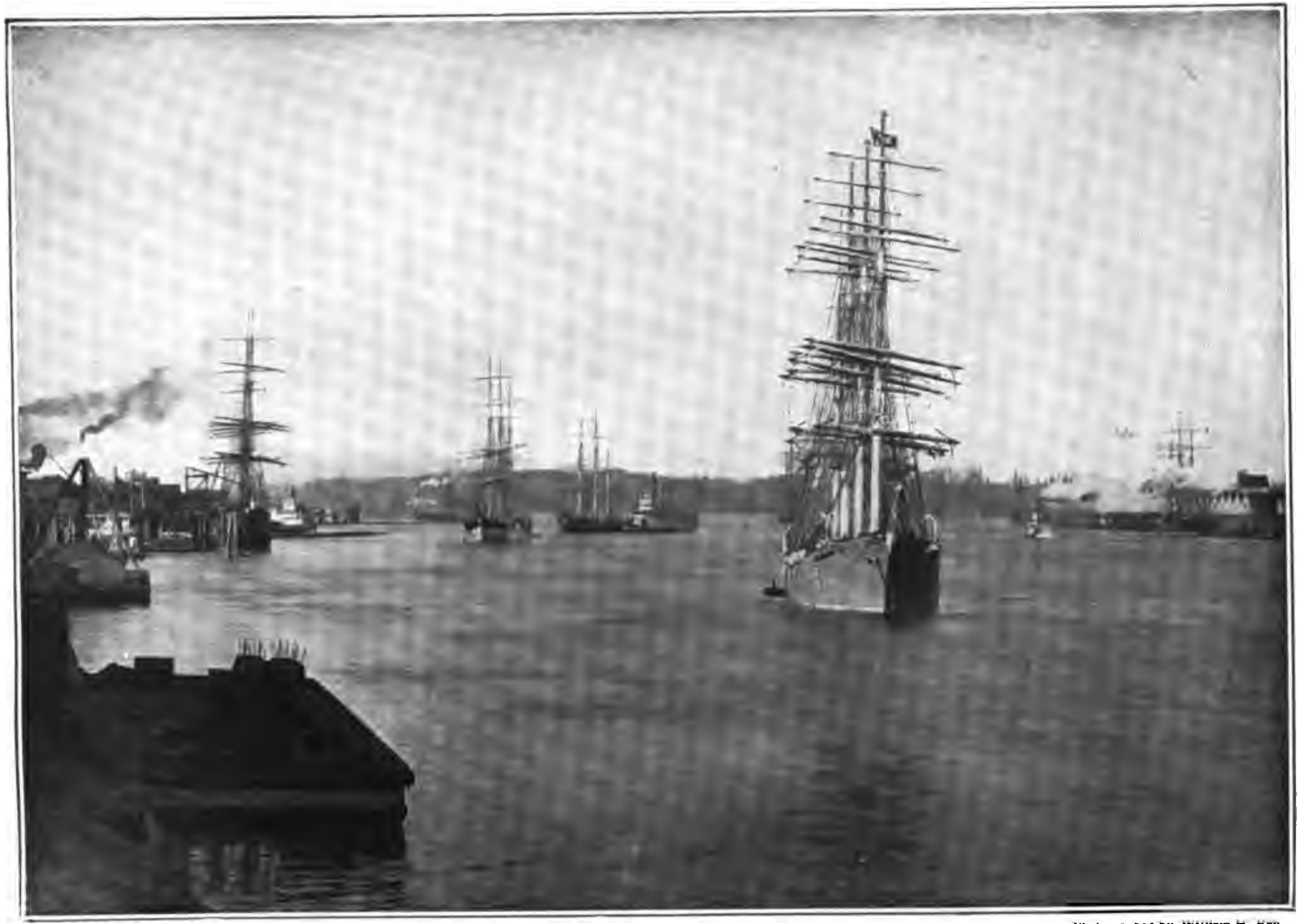
Trade and Commerce.— In the earlier days Portland had an extensive and valuable trade with the West Indies, a portion of which it still enjoys. It has large commercial interests and is noted for its exports of grain, fruit and livestock. Exports in 1916 from Grand Trunk piers and elevators: Grain, 1,092,622 tons; package freight, 122,593 tons; horses, 22,593; mules, 6,194; also 39,083 pieces of cooperage stock. Imports (trans-Atlantic), 16,260 tons; sulphur, 102,344 tons; pulp wood, 20,205 tons; china clay, 38,861 tons; fire clay, 13,315 tons; lumber, 1,575 tons; ore, 6,644 tons. The fish receipts were approximately 13,960 tons. Miscellaneous: Mexican crude petroleum oil, 21,769,104 gallons; coal, 1,511,168 net tons; salt, 3,184 tons; through this port by water, 75,614 tons. The harbor is of easy access, capacious, safe, deep enough for the largest vessels and rarely obstructed by ice; hence it is an important seat of winter traffic between Great Britain and Canada. There are docks and other facilities for the repair of vessels. The greater part of the steamship-carrying trade to and from foreign parts is in British ships. The coasting trade is extensive. England, France, Portugal, Uruguay, Haiti, Argentine Republic, Norway and Sweden maintain consular service here.

Newspapers.— Portland has 14 newspapers; six political, two religious, one agricultural, one Masonic, four miscellaneous.

Banks.— There are five national banks, with a capital of $2,000,000; five trust companies, with a capital of $1,000,000; two savings banks (resources), $34,186,217.25.

Insurance Companies.—Two, with assets of $18,537,161.04.

History.— In 1623 Christopher Levett of York, England, visited the Maine coast and under a patent embracing the present site of Portland built on one of the islands in the harbor a fort, in which he placed 10 men and sailed for England, intending to return and plant a colony. To the site of his proposed plantation he gave the name York, from his native city. The project failed, owing to war between England and France, and the place remained uninhabited by Europeans until 1632, when George Cleeve and Richard Tucker of England made a settlement on the eastern ex-



Photographed by William H. Rau

RIVER FRONT OF PORTLAND

PORTLAND, MAINE

1 Birthplace of the Poet Longfellow

2 A View of Portland Head

tremity of the peninsula within the limits of the present city of Portland. The Indian name of the place was Machegonne and was entitled in the patent to Cleeve and Tucker Stogomor, from Stogumber, the birthplace of Tucker. This was shortly changed to Casco Neck. In 1658 the name was changed to Falmouth. The Indians made an attack on the town in 1676, burning houses, killing some of the inhabitants and making many captives. It was completely destroyed by the French and Indians in 1690. The General Court authorized its resettlement in 1714, and in 1716 it was resettled by Col. Samuel Moody, who soon gathered about him about 50 families. On 10 March 1719 the first town meeting was held. The town suffered severely during the Revolutionary War from a bombardment by a British fleet in 1775. It was again rebuilt, and in 1836 received its first city charter. On 4 July 1866 a fire destroyed 1,500 buildings, involving a loss of $10,000,000. Longfellow, N. P. Willis, William Pitt Fessenden, Neal Dow and Thomas B. Reed were natives of Portland. Pop. at present time estimated at 65,000.

Bibliography.— Neal, ‘Portland’ (1874); Willis, ‘History of Portland’ (1865); Elwell, ‘Portland and Vicinity’ (1876); ‘George Cleeve and His Times’ (1885); ‘Portland in the Past’ (1886); ‘Christopher Levett’ (1893); Powell, ‘Historic Towns of New England’ (1898).

JAMES PHINNEY BAXTER.

PORTLAND, Ore., chief city of the State and county-seat of Multnomah County, situated just above the confluence of the Willamette and Columbia rivers, a position made doubly important through the continuous improvement of these great commercial waterways by the United States government and the port of Portland. The city is 771 miles north of San Francisco, 115 miles from the ocean and covers an area of 66.36 square miles. The population of the city is steadily increasing at a rate approximating 10 per cent annually. It is called «The Rose City» in appreciation of the fact that its people pay special attention to the beautification of their homes and especially to the planting of rose gardens and hedges. Portland is unique in its efforts to develop the country throughout the State and this policy has reacted very advantageously indeed on the trade of the city. Geographical contours give a water-level route from far in the interior. Railway lines operating on this grade pour their traffic into the city most economically as a consequence. The splendid fresh-water harbor is the best one on our Pacific Coast and there is better than a 30-foot channel to the sea at low tide with 35 feet assured in the near future.

Columbia River Entrance.— The entrance to the Columbia River is deeper than any other Pacific Coast port, the most recent government figures showing a depth of water in excess of 42 feet for a width of over half-a-mile and a depth of 35 feet for an additional half-mile of width. The United States government has spent $16,000,000 to remove what was once considered a hazardous bar at the mouth of the Columbia. This obstruction has been entirely removed by the construction of two long jetties, one on either side of the river entrance. The waters of the Columbia constantly are scouring the channel and the depth of water is increasing year by year. Portland is the chief lumber manufacturing city in the world. The by-product of lumber is the manufacturing of furniture, the city having some of the largest furniture manufacturing plants in the United States. Portland is also the chief wheat exporting port of the Pacific Coast and in normal times the second largest wheat shipping port in the United States, handling the bulk of the great crop produced in the Inland Empire (eastern Oregon, eastern Washington and Idaho), and in 1915 the wheat receipts of the city mounted to 18,718,755 bushels. Portland has 772.39 miles of improved streets; of this, 384 miles are hard surfaced, 116.30 miles macadam and gravel, and 269.66 miles graded. Completed sewers show a total of 574 miles. The assessed valuation of taxable property in Portland at the end of 1918 was $305,200,640. The tax rate is $1.20 per hundred dollars and the net bonded indebtedness of the city is $11,859,011.38.

Streets and Parks.— Portland is continuously improving its streets and in this respect stands among the most modern cities of the country. Blocks are 200 × 200 feet, with no alleys, giving the city a fine appearance. The city is a huge park, in that great Douglas fir trees, oaks and cedars and other large growths grow on the hills and close down to the border of the city limits. The streets are lined with shade trees and practically every home has its lawn and rose hedges. Boulevards run along each side of the river, both above and below the business district. Council Crest drive is one of the city's show places, because of the vast panorama of mountain, hill, valley and city that unfolds to the view of the spectator. Terwilliger boulevard, following the contour of the hills on the west side of the river, is a connecting link of an extensive chain of scenic roads that lead from the city into beautiful verdure-garbed valleys dotted with orchards and farm homes.

Columbia River Highway.— The Columbia River highway, along the east bank of the Columbia River, is said to be the most beautiful highway in the world. It traverses the gorge of the Columbia River for 50 miles east of Portland. This portion of the highway is hard surfaced. By the fall of 1920 the Columbia River highway will be completely hard surfaced from Pendleton in eastern Oregon to Astoria, at the mouth of the Columbia River, a distance of 370 miles. The Pacific highway, from Portland south to the California line, is also a wonderful roadway. Hard surfacing will also be completed by the fall of 1920, the distance being about 360 miles. Oregon is spending $33,000,000 on her highways in the next three years. Portland's park area compares favorably with other cities of its size. Washington Park is situated on the edge of the western hills, a most sightly location, where some of the most magnificent views of the city and mountain peaks are to be obtained from an eminence in this park. Another one of the interesting parks of the city is Peninsula Park, where are to be found beautiful sunken gardens, said to be the largest rose park in the United States and accessible by street car from the centre of the city. Macleay Park is situated in the Willamette Heights district and was donated by an early pioneer with the request that its natural ruggedness be maintained in its present state.

There are 21 parks and playgrounds in and about the city, many of which are highly improved. In addition to public parks, Portland has four splendid golf courses, one of which is controlled by the municipality, also a number of fine privately controlled amusement parks.

Libraries.— Portland is the seat of the magnificent new Multnomah County Library. This, with five tastefully designed and substantial branch buildings and 12 sub-branches and 22 deposit stations, gives easy access to its privileges from every portion of the city; its circulating rural libraries throughout the entire county and affiliations with suburban communities make this institution unique among American libraries. A feature of the new building is a series of commodious halls, available without charge for meetings of a civic or development nature. More than 50 organizations regularly avail themselves of this opportunity. The circulation is about 1,385,964 volumes annually. Portland, according to the latest available government statistics, is the most highly cultured city in the United States; the percentage of illiteracy is but 1.2 per cent.

Schools and Education.— Portland has an excellent public school system. There are 71 school buildings in the city under the control of the school board. There are 1,202 teachers and supervisors employed, and 44,996 pupils enrolled, segregated as follows: Elementary schools, 35,636 pupils; high schools, 4,672 pupils; trade schools, 1,623 pupils; night schools, 3,065 pupils. There are four special schools and many private schools of high class and efficiency, as well as numerous trade and technical institutions. The University of Oregon maintains its medical department in this city. The largest dental college on the Pacific Coast, teaching dentistry and pharmacy, is located in Portland, besides private medical institutions and law schools. A public art institution fosters the fine arts. The Reed College is an institution offering courses of the highest order in the arts and sciences. It has a large endowment fund and is fast forging to the front as a school of national prestige. Music conservatories and voice culture schools rank among the highest in the country.

Newspapers.— Five daily newspapers are published in Portland, the *Oregonian*, *Oregon Journal*, *Evening Telegram*, *Portland News* and the *Nachtrichten* (German), with an additional 80 semi-weekly, weekly and monthly publications.

Climate.— Portland has an equable climate. The summers are cool and comfortable, the winters mild and rainy. For a period covering the last 30 years the United States Weather Bureau gives the average annual rainfall as 45 inches; the average yearly temperature was 52.4°. There are no destructive storms, wind or electric disturbances.

Churches.— Portland has 213 churches, with church buildings valued at approximately $3,150,000. The Y.M.C.A. and Y.W.C.A have large memberships and splendid buildings of their own. The B'rai B'rith have also a building of their own.

State Exhibit.— The State of Orgeon maintains an exhibit of Oregon products, agricultural, mineral and manufactured, on the ground floor of the Oregon building, in which building also is located the Chamber of Commerce with an information bureau for home-seekers. The Portland Chamber of Commerce maintains several bureaus where the home-seeker, investor or tourist may secure information pertaining to any particular subject in which he may be interested. The Oregon development bureau of the Chamber of Commerce is of special interest to the home-seeker. Information as to lands and agriculture and advice is furnished free of charge.

Clubs and Commercial Organizations.— Club life is well developed here. In addition to various social organizations there are strong commercial bodies. The Portland Chamber of Commerce is one of the largest in the world. The East Side Business Men's Club, Press Club, the Portland Ad Club, Civic League, Progressive Business Men, Realty Board, Rose Festival Association, Rose Society, Royal Rosarians, the Kiwanis and Rotary Club deal with public questions and do valuable publicity work. All have large memberships, made up of the most substantial business interests in the city. There are many social, educational, literary and musical clubs. The city is widely known for its symphony orchestra. Notable among the clubs owning their own homes are the Arlington Club, University Club, Elks Club, Multnomah Club, Oregon Yacht Club, the Hunt Club, Irvington Tennis Club, Rose City Park Club, the Laurelhurst Club, Portland Heights Club, Concordia Club, Waverly Golf Club, Tualatin Country Club, Portland Rowing Club. The holdings of these clubs would aggregate more than $3,000,000.

Lumber.— There is tributary to Portland 564,000,000,000 feet of merchantable timber, consisting of yellow and red Douglas fir, yellow, white and sugar pine, spruce, cedar, hemlock, larch and other commercial woods. During the great European War, Portland, which is the largest lumber manufacturing city in the world, was governmental headquarters for spruce production for aeroplanes.

Manufactures, Commerce, etc.—The city is rapidly forging to the front as a manufacturing centre and is one of the chief manufacturing cities in the Pacific Northwest and is the centre of the jobbing trade. There are 950 manufacturing establishments here, representing an investment of $75,000,000. There are 40,000 factory employees, officials and office men, whose wages amount to $65,000,000 per annum. The value of the product in 1918, not considering shipbuilding, was $200,000,000. The principal lines of manufacturing are lumber and its by-products, flour, furniture, woolens, harness and saddlery, machinery, fruit-canning and meat-packing and railroad cars and equipment. Portland's shipbuilding contracts for the period of the war approximated $230,000,000. Oregon and the Portland district were the largest producers of commercial ships, steel and wood, in the United States during the war. Portland has been the business centre of the Oregon country since the earliest days, when the State name included the whole Pacific Northwest. This city has been the banking centre for this corner of the United States and her banks are the largest and most substantial in the territory. They have a wide reputation for strength and conservative methods. Portland

PORTLAND, OREGON

1 View of Portland, showing Mount Hood

2 View of Portland Harbor

Scene in Portland harbor

has 23 banks, eight of which are national institutions. In 1918 the bank clearings amounted to $1,323,082,798.21 and the deposits for the year ending 31 Dec. 1918 aggregated $140,-299,968.19. Postal receipts for 1918 were $1,630,000; postal savings for 1918 were $1,800,000.

Livestock Markets.— The rapid and substantial growth of the Portland Union stockyards since their opening in 1909 has conclusively demonstrated that Portland is the one great livestock centre on the Pacific Coast. In fact, it is the only competitive market west of Denver, and is growing in importance each year. Portland's livestock industry in 1918, including packing-house products, involved $75,000,000.

Railroads.— Portland's growth as a railroad centre within the past few years has been almost phenomenal. The fall of 1906, when the Spokane, Portland and Seattle (the North Bank Road, affiliated with the Hill system) was built down the north bank of the picturesque Columbia River at a cost of $53,000-000, marked the opening of a new era in railroad development for Portland, since which time millions of dollars have been expended annually within the State in railway improvement and extension. The completion of this line opened up a vast new territory to Portland. Then came the extension of the Oregon-Washington Railroad and Navigation Company (Harrison system) and the building of the Oregon Trunk (Hill system). The city is also reached from the south by the Southern Pacific. Building of feeder lines, double-tracking and electrifying of present systems, is going on continuously in the territory contiguous to Portland and numerous electric interurban lines stretch out in all directions from the city throughout the Willamette Valley. Most notable among these latter are the Oregon Electric (Hill system) with a total mileage of 154 miles; the United Railways operate in connection with the Oregon Electric, which operates from Portland to Linnton and Wilkesboro, in Washington County, a distance of 28 miles, and the Portland, Eugene and Eastern branch of the Southern Pacific, which has a network of electric lines throughout the Willamette Valley. Two main depots give excellent passenger accommodations and freight terminals and warehouse facilities here are constantly being enlarged to meet requirements of ever-increasing traffic. The great transcontinental railway systems operating into Portland at present include the Northern Pacific, Great Northern, Burlington, Union Pacific, Southern Pacific and Canadian Pacific.

Water Transportation.— Portland's commerce reaches every prominent port. Steamship lines ply to the Orient, to Pacific Coast ports and to the Atlantic Coast via the Panama Canal. The Panama Canal affords much closer connection with Atlantic ports and is having important bearing on Portland's progress. Tramp steamers and sailing vessels carry lumber and wheat from Portland to world markets and the great foreign shipping-houses have branches here. The harbor is in the heart of the city and vessels dock close to wholesale and warehouses.

City and Interurban Transportation.— Excellent street car service is afforded by the Portland Railway, Light and Power Company. The street car mileage of this company totals 215.49 miles within the single-fare zone. Only cars of the most modern type are used, embodying the latest improvements for safety and comfort of the passengers. Frequent interurban electric trains connect Portland and the surrounding district for a radius of from 25 to 125 miles.

Water, Electricity and Gas.— Portland's pioneers were far-sighted and made reservations of Bull Run River, a splendid mountain stream, for the perpetual domestic water supply of the city. A municipal gravity system has been built that brings the water from its source, the Bull Run River, which is fed by melting mountain snows, through conduits for a distance of 24 miles. There is ample supply for all purposes and the water is remarkably soft and pure. Over 67,000,000 gallons of water are carried through two huge pipe lines to the city every 24 hours. The city in 1918 possessed 738 miles of water mains. The chief supply and distribution of electricity for light and power purposes is made by the Portland Railway, Light and Power Company, which operates five water-power plants and four steam plants with a total capacity of 109,340 horse power. The power furnished by this company is all generated within 40 miles of Portland, the hydraulic plants being located on the Willamette River, Clackamas River and Bull Run River. This arrangement, in connection with the five steam plants, ensured reliable service to all parts of the company's system. Some parts of the city are also supplied by the Northwestern Electric Company, with a hydraulic generating plant at White Salmon, Wash., and two steam plants in the city with a present capacity of 34,500 horse power. These two systems combined have a generating capacity in excess of the present demand of approximately 65,000 horse power, ensuring an ample power supply for Portland to meet future demands. There are 50,000 consumers of electricity within the territory served by these light and power companies. Gas for lighting, heating and power purposes is adequately supplied to all parts of the city by the Portland Gas and Coke Company.

History.— When William Overton in November 1843 landed his Indian canoe on the river's western bank and examined the townsite of Portland, now spreading for miles along both shores, his imagination probably did not suggest to him its present magnitude. A solid mass of forest and underbrush, skirted on the one side by the Willamette River and on the other by massive hills, was all that met his view. With William Overton was A. L. Lovejoy, having come from the Hudson Bay Company's resort at Vancouver, Wash., and decided this was the best location for a town site. Mr. Overton disposed of his property to F. W. Pettygrove and the latter and Mr. Lovejoy had the site surveyed and the boundaries established during the summer of 1844. They recognized the advantages of the location and reasoned that some day it must not only become a metropolis of a vast region but also one of the chief seaports of the Pacific Coast. The first house, made of logs, was built in the winter of 1844. F. W. Pettygrove was a native of Maine and A. L. Lovejoy of Massachusetts. The former wanted to name the new town Portland and the latter favored Boston. It was decided by the toss of a coin — «Heads it is Portland,» «Tails it is Boston» — Pettygrove winning twice out of three. Portland was incorporated in 1851. The first city election held 7 April 1851 showed a total vote cast of 140. In 1860 the population was 2,874. The population has more than doubled each decade. If these founders of Portland could now return for one brief moment, the scene which would meet their eyes would without doubt surpass their most sanguine anticipations. They might easily recognize the beautiful snow-capped mountains and nature's many artistic environments of their pioneer home, but this is all that would appear familiar to them. They would find a cosmopolitan city, large blocks of commercial buildings, massive and at the same time models of architectural beauty, while the residences, churches and schoolhouses are not surpassed by those of equally large cities of the East. Pop. 330,000. Consult Gaston, Joseph, 'Portland, Ore.: Its History and Builders' (3 vols., Chicago 1911).

Sydney B. Vincent,
Portland Chamber of Commerce.

PORTLAND, Isle of, a peninsula of the coast of Dorsetshire, England, about four miles long and of an extreme width of one and three-fourths miles. Only on the south is it accessible from the sea, its shores being wild and precipitous. Once an island the waves have built up a narrow ridge of shingle, Chesil Bank, which connects it with the main land. Great quantities of building stone have been taken from its beds of Oölitic limestone, including material for Saint Paul's, London. Portland Castle was built by Henry VIII in 1520. Pop. 17,011.

PORTLAND CANAL, a narrow body of water separating Alaska from British Columbia, and extending for over 80 miles in a northeastern direction. Its shores are precipitous cliffs of from 3,000 to 6,000 feet in elevation.

PORTLAND CEMENT. Portland cement is the product obtained by finely pulverizing clinker produced by calcining to incipient fusion an intimate and properly proportioned mixture of argillaceous and calcareous materials with no additions subsequent to calcination excepting water and calcined or uncalcined gypsum.

The old Roman cements were natural cements or were a mixture of slaked lime and volcanic dust which was found in large quantities in Italy. Indications are that concrete was prepared much as it is to-day and even this combination which is crude in comparison with the modern portland cement concrete produced·an artificial stone which has stood the test of time. There is a gap of about five centuries between the Roman times until the next record of the use of cement. In 1756 John Smeaton, an engineer who constructed the Eddystone lighthouse in the English Channel, while searching for a suitable mortar discovered that an impure limestone containing a certain amount of clayey matter possessed decided hydraulic properties when calcined or roasted.

These early natural cements were very different from modern cements, however. It was necessary to use rocks with the proper proportion of material in their makeup and any variation in the composition could not be regulated since the nature of the material was not understood.

Portland cement originated with Joseph Aspdin, a bricklayer of Leeds, England, who in 1824 took out a patent for a cement to which he gave the name of «Portland» on account of its resemblance when hardened to the famous stone used extensively for fine building and found on the Isle of Portland on the northern coast of England. It is interesting to note that about a quarter of a century later came one of the earliest recorded uses of the modern reinforced concrete construction in the building of a reinforced concrete rowboat by M. Lambot, near Carces, France, which is the forerunner of the modern concrete ship.

In his patent, Aspdin signified that definite amounts of clay and limestone be used and described a process of putting these two materials together, then calcining them in the manufacture of his «Portland» cement. This is the distinction between natural and portland cements. As one writer has said, «A natural cement is a gift of Nature depending as it does upon Nature for the proper materials correctly proportioned for the manufacture of cement. A portland cement is a manufactured product, its composition being governed at all times by the proper selection of raw materials of which it is made, and any variation in the composition of these raw materials is easily detected and it is, therefore, a highly dependable product.»

The history of the commercializing of portland cement is a history of inventions and improvements in its manufacture. In this, American engineers and inventors have had remarkable success, for although this country was one of the last to begin the production of portland cement the output to-day has far outstripped that of Europe.

Aspdin's portland cement was found greatly superior to the Roman cement, Puzzoulana cement and hydraulic lime previously used and its manufacture extended rapidly, especially in England and Germany. In this country it was first successfully made at Coplay, Pa., in 1878 but until 1890 practically all the portland cement used in this country was imported from Europe. After that date the industry increased with great rapidity until the United States ranks as the chief cement producing country of the world. From a production of 42,000 barrels of portland cement in 1880, the annual output in the United States rose to nearly 93,000,000 barrels in 1917.

Modern portland cement is manufactured from a mixture of two materials, limestone rock or similar material like chalk or marl which is nearly pure lime and another material supplying the other ingredients needed which is usually shale or clay although blast furnace slag is also used in conjunction with limestone. The one supplies the calcareous materials and the other the argillaceous or clayey materials. It is essential that the mixed raw materials contain certain exact percentages of these ingredients; this proportion differs slightly with different materials but ranges generally 75–80 per cent of carbonate of lime to 25–20 per cent of anhydrous clay.

Material for portland cement must be comparatively free from magnesia since the specifications limit the magnesia content to 5 per cent. The clay or shale must be siliceous, preferably containing two and one-half to three times as much silica as alumina plus iron oxide. In preparing the mixture the proportions must be correct and uniform. It is found that the best results are obtained with mixtures in which the percentage of lime is = 2.8 silica + 1.1 alumina.

In the manufacture of portland cement, the first essential is to mix the raw materials in the correct proportions and grind the mixture to a high degree of fineness. Failure to produce cement of good quality results more often from neglect of the latter precaution than from all other causes combined. In England, the mixture of chalk and clay was generally made by the wet process, in which the materials were stirred with water in wash-mills and the "slurry" allowed to settle in large reservoirs until firm enough to be cut into blocks and dried by the waste heat of the burning kilns. The dry process is generally used in the case of limestone and cement rock, both in Europe and America, although a number of plants using limestone and clay are operating on a semi-wet process. In the dry process, the materials are crushed, dried and finally ground together in tube mills which consist of revolving cylinders partly filled with rounded pebbles. Marl and clay are usually treated by a wet process, in which the materials are mixed as taken from the beds and ground in tube mills with sufficient water to make a thick slurry.

The burning of portland cement was formerly done in simple, intermittent vertical kilns similar to lime kilns or in ring kilns consisting of a number of chambers connected to a central stack into which the fuel was introduced through openings in the roof. Later, continuous kilns were adopted in which the bricks of dry slurry and the fuel were fed in at the top and the clinker periodically withdrawn at the bottom. These three classes of kilns required the materials to be molded into bricks and dried, an operation involving much labor.

In 1885 Ransome patented in England a process of burning cement material in the form of powder in revolving kilns heated by a flame of gas. The invention was a failure in Europe but was taken up and developed by American engineers and found to be especially adapted to conditions in this country. Petroleum was first used as fuel and later this gave place to powdered coal blown in by a blast of air. The rotary process was found to yield cement superior in several respects to the product of the older types of kiln and to be adapted to the burning of cement mixture in the form of dry powder or wet slurry without previous molding into bricks. With the advantage of the rotary kiln, the American portland cement industry began, about 1890, a career of wonderful expansion and development which is still in active progress. At the present time there are more than 600 kilns of this type in operation in the United States and many have been built after American designs in the leading factories of Europe.

There are three distinct and separate operations from the preparation of the raw material to the finished product. The first is mechanical and includes the assembling, preparing, grinding and amalgamating of the raw materials; the second is chemical, during which the material prepared by the first process is calcined or roasted at a high temperature, bringing about chemical composition of the various ingredients. The third and final process is partly mechanical and partly chemical, in which the clinker resulting from the calcination together with a small percentage of retarder is reduced to a fine powder.

In the dry process the raw materials are quarried, crushed, dried, pulverized, and mixed in the proper proportions. The powdering or pulverizing of the raw materials is one of the most important steps in cement manufacture and decided advances have been made in the last few years in grinding and pulverizing machines. Grinding machines nearly all work on the principle of striking or pounding the material between a hammer in some form and a solid metal mass.

After the raw material has been prepared for mixing this operation is accomplished by means of automatic weighing machines which weigh out just the right quantity of each of the two materials. These machines are always under the direct control of the chemist in charge of the operation day and night. There is then a perfect grinding of the raw materials to fine powder called the "raw mix." In the wet process used by some plants, a slurry is made containing the proper amount of each raw material which is then put in storage tanks and from there pumped into the rotary kilns.

The modern rotary kiln consists of a steel cylinder lined with fire brick, generally 60 to 220 feet in length and from 6 to 12 feet in diameter, set in a slightly inclined position upon rollers so that the raw material when fed into the upper end gradually moves toward the lower or discharge end as the kiln slowly rotates about its own axis. The output of the rotary kiln is from 150 to 2,000 barrels each per day. In these kilns the raw mix is burned or "calcined to incipient fusion" by powdered coal blown in at the lower end through a hood with 50 to 100 per cent excess air over the amount theoretically required for combustion of the coal.

The cement mixture in powder or as wet slurry is continually fed in at the upper end and as it travels downward becomes dried (if wet) and is gradually brought to the white heat of the hottest zone, issuing finally in the form of black, rounded nodules of clinker varying in size from birdshot to perhaps two inches. The clinker is cooled and then ground and pulverized to fine powder usually in mills of the pendulum type or in tube mills. About 2½ per cent of gypsum is ground with the clinker to regulate the time of set of the cement. The fineness of grinding is such that at least 78 per cent of the product will pass a sieve of 200 meshes to the linear inch. After the cement has been ground it is usually deposited in bulk bins holding several thousand barrels each. Samples are then taken and complete tests made for fineness, setting, soundness, strength, chemical analysis, etc.

Portland cement is a gray powder weighing from 80 to 110 pounds per cubic foot, depending upon its fineness and how much it has been compacted; in actual practice a sack of cement is ordinarily considered as containing one cubic foot and weighing 94 pounds net. Mixed with water to a paste it sets or hardens slowly, resisting pressure of the finger nail after several hours. After setting it gains rapidly in hardness during the first 30 days, the increase continuing, though more slowly, through a long period of years.

In testing portland cement, the most important qualities to be observed are fineness, time of setting, tensile and compressive strength and soundness. Fineness is determined by sifting through standard sieves of the correct number of meshes and gauge of wire. The time of setting is determined by preparing a test piece of suitable form from neat cement and noting the time at which needles of certain definite size and having certain definite weights cease to make appreciable indentations on the test piece. A needle exerting a different unit pressure on the test piece is used for determining the initial set from that used for determining the final test. For tensile strength briquettes one square inch in smallest section are made by filling standard molds with a plastic paste of cement and sand. These are kept 24 hours in moist air, then immersed in water and broken in a testing machine at the age of 7 and 28 days and if desired at longer periods. Soundness or constancy of volume is tested by making pats of cement with thin edges on plates of glass, keeping them in moist air 24 hours and then exposing in a loosely covered vessel to an atmosphere of steam above boiling water for five hours. These pats should remain firm and hard and show no signs of distortion, cracking, checking or disintegration.

The use of concrete is continually extending and being applied to many new enterprises in the structural and commercial fields. The construction of concrete roads and streets is perhaps the most prominent development of the past decade and has reached such proportions that there are at the present time practically 150,000,000 square yards of such pavement in the United States, an amount sufficient to make nearly 15,000 miles of 18-foot highway. The recent war brought the practical development of the ocean-going concrete ship of large tonnage and the concrete barge for harbor and inland waterway transportation, also the underground concrete tank of large capacity for the storage of crude oil, fuel oil, etc. New uses for the material are discovered almost daily so that the present century may well be called the Cement Age.

PORTLAND STONE, (1) in England, a limestone of the Upper Oölite, located between the Purbeck Beds, the highest of the Jurassic Epoch, and the Kimmeridge Clay. It is so named from the Isle of Portland. It was used in the construction of Saint Paul's Cathedral, Somerset House and other notable buildings. (2) In the United States, the name is applied to the brownstone, much used as a building stone in New York, quarried at Portland, Conn. This belongs to the New Red Sandstone of the Triassic Epoch.

PORTLAND VASE, a cinerary urn or vase and a beautiful specimen of Greek art found in the marble sarcophagus of the Emperor Alexander Severus at Monte del Grano, near Rome, during the pontificate of Urban VIII (1622–44). It is formed of glass of a dark-blue color, and is ornamented with relieved figures in white enamel, representing the marriage of Peleus and Thetis. It is 10 inches high, seven in diameter at the broadest part, and is furnished with a handle on each side. It was placed in the Barberini Palace, where it remained till 1770, when it was purchased by Sir William Hamilton, from whose possession it passed into that of the Duchess of Portland. In 1810 the Duke of Portland gave it on loan to the British Museum, of which he was a trustee. In 1845 a stupidly malicious fellow, or more probably a lunatic, who had been admitted to the museum as a visitor, deliberately smashed it with a stone. It was skilfully repaired, however, and is exhibited to visitors.

PORTO ALEGRE, pŏr'too ā-lā'grā, Brazil, capital city of the state of Rio Grande do Sul, about 710 miles from Rio Janeiro, on the left bank and near the mouth of the Jacuhy River, and northwest of the Lagoa dos Patos, on railroads connecting it with the interior. The streets are broad and clean with handsome squares. The charm of the city and its surroundings gave it the Portuguese name of «Smiling Harbor» (Porto Alegre). A hospital, theatre and cathedral are the main public buildings. There are good schools and a large colony of Germans, who, prior to the World War, handled most of the city's commerce. This consists chiefly of the produce of the rich agricultural and grazing lands. It has several steamboat lines to Rio Janeiro, to the former German colony of São Leopoldo, etc. The imports are mostly English and German wares. Porto Alegre was founded in 1742 by colonists from the Azores. Pop. 100,000.

PORTO CABELLO. See PUERTO CABELLO.

PORTO MAURIZIO, Italy, the capital and chief town of the province of Porto Maurizio. It is situated on a promontory projecting into the Ligurian Sea, 14 miles from San Remo, 58 miles by rail southwest of Genoa and 41 miles by rail east by north of Nice. The harbor is formed by two moles and is entered from the south-southwest. Olives are produced in considerable quantities, and there is an extensive shipping trade in fish, agricultural produce and olive oil. The town consists of an old section on a hill and a new section near the sea, the latter containing a fine church, a theatre, a technical school, a school of navigation and a library. Pop. 11,603. Pop. of province, 141,778.

PORTO RICO, pŏr'tō rē'kō, or **PUERTO-RICO**, an island of the West Indies and a possession of the United States; the easternmost and smallest of the group of Greater Antilles, about 1,400 miles from New York, 1,000 miles from Havana and less than 1,000 miles from Colón, Republic of Panama; lying between lat. 17° 50' and 18° 30' N. and long. 65° 30' and 67° 15' W. The estimate of its area commonly accepted is 3,608 square miles, or, without Vieques, 3,550. Adjacent and subject to the same jurisdiction are the small islands Vieques and Culebra, in the passage between Porto Rico and the Virgin group; Mona, between Porto Rico and Santo Domingo, and a few other islets.

Topography, Climate and Hydrography.—A chain of mountains, the summits of which

PORTO RICO.

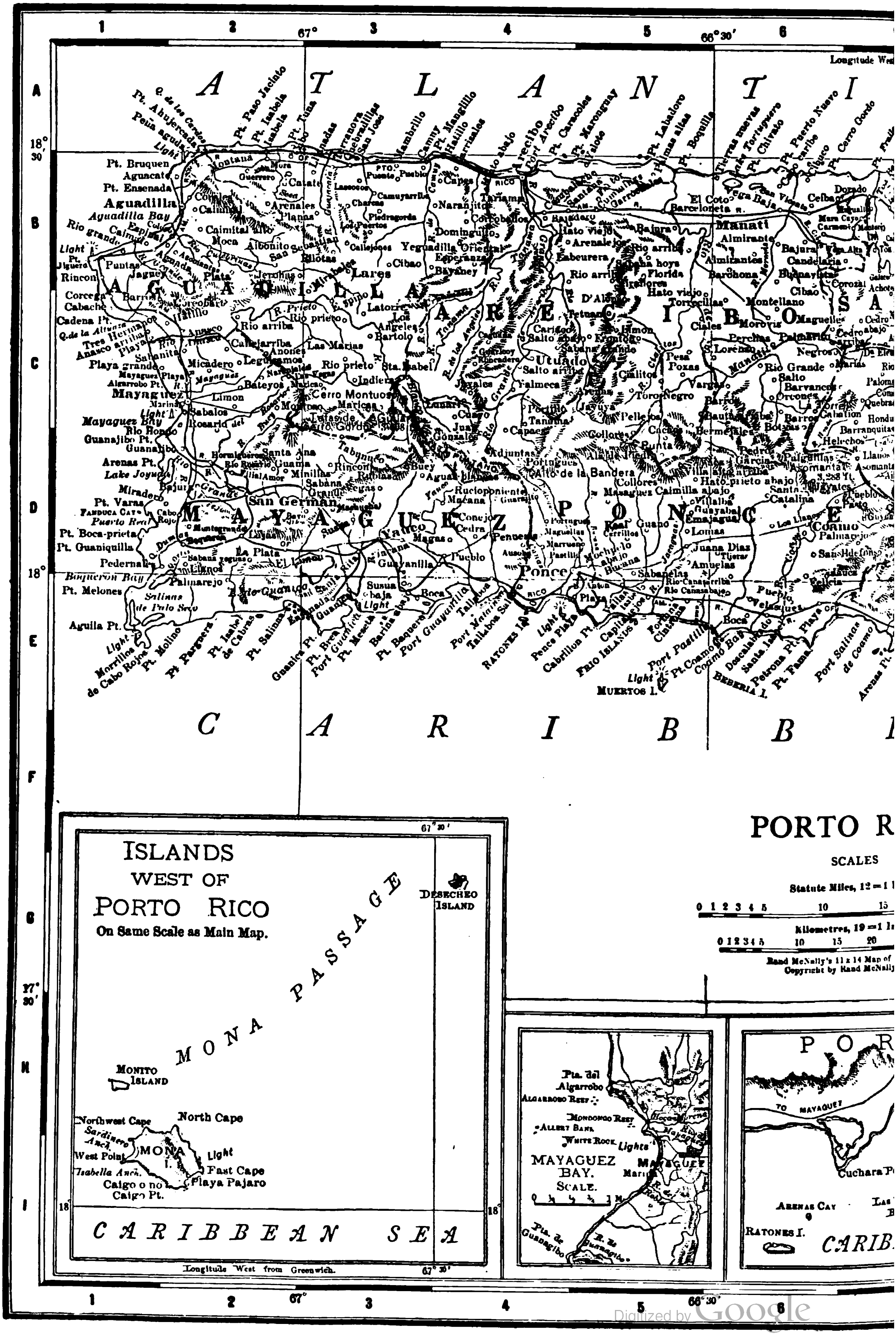
Estimated population, 1,216,083

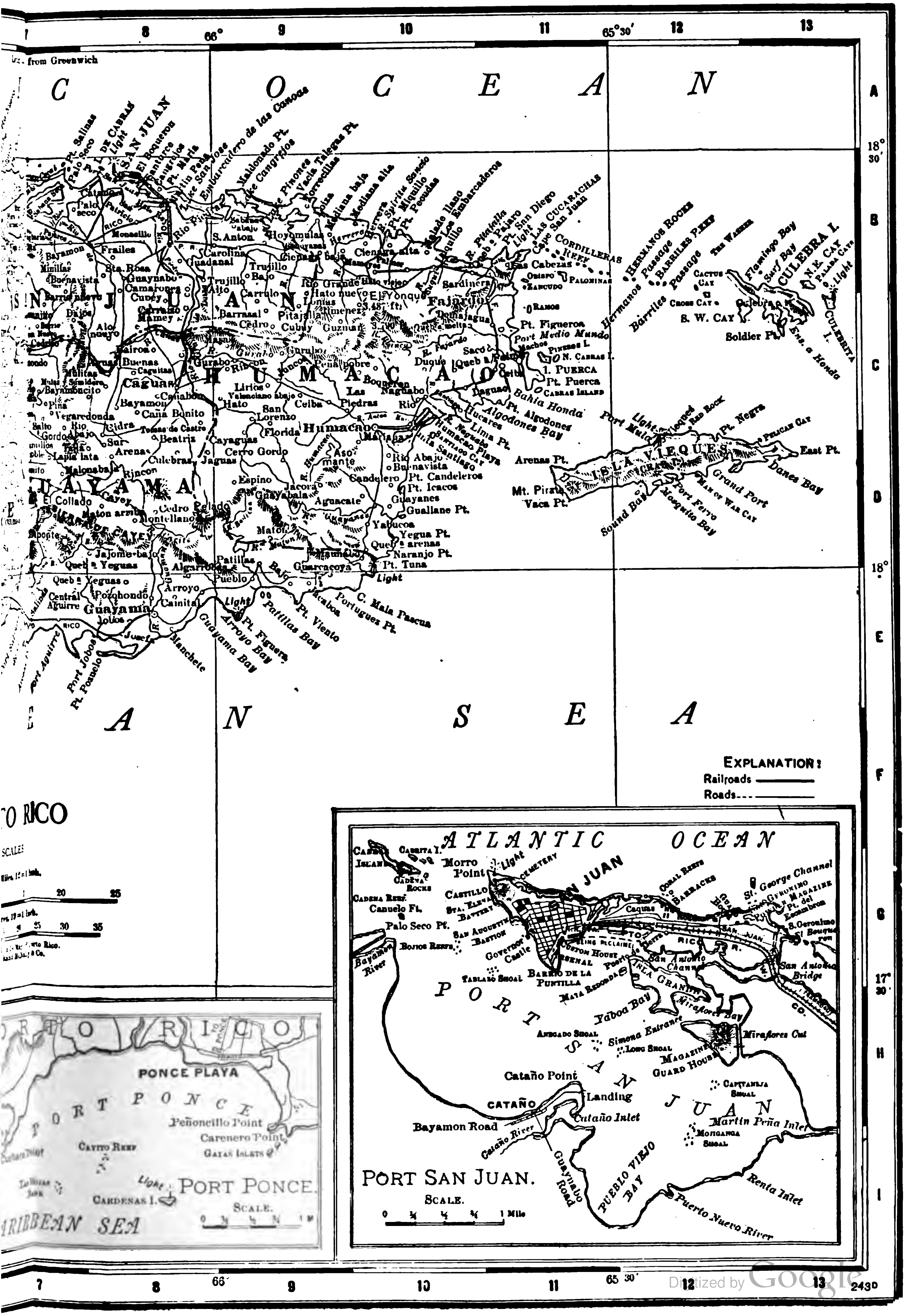
DEPARTMENTS

Pop.			Pop.		
99,645	Aguadilla	B 2	127,566	Mayaguez	D 2
162,308	Arecibo	C 5	203,199	Ponce	D 5
111,986	Guayama	D 7	160,046	San Juan	C 7
81,859	Humacao	C 10			

Cities

1,406	Adjuntas	D 4
909	Aguada	B 2
6,135	Aguadilla	B 1
1,166	Aguas Buenas	C 8
2,153	Aibonito	B 2
3,064	Añasco	C 2
9,612	Arecibo	B 4
3,220	Arroyo	E 8
772	Barranquitas	C 7
1,008	Barros	C 6
693	Barceloneta	B 5
5,272	Bayamon	B 7
3,847	Cabo Rojo	D 2
10,354	Caguas	C 8
1,148	Camuy	A 3
3,244	Carolina	B 9
4,786	Cataño	B 8
4,498	Cayey	D 8
920	Ceiba	B 6
1,683	Ciales	C 5
1,535	Cidra	C 8
3,869	Coamo	D 6
1,908	Comerio	C 7
1,301	Corozal	B 6
384	Culebra, Humacao	D 10
946	Dorado	B 7
6,086	Fajardo	C 10
1,768	Guanica	E 3
8,321	Guayama	E 8
1,141	Guayanilla	D 3
2,230	Gurabo	C 9
599	Hatillo	A 4
348	Hormigueros	D 2
5,159	Humacao	C 10
1,268	Isabela	A 2
750	Jayuya	C 5
2,092	Juana Diaz	D 5
4,141	Juncos	C 9
720	Lajas	D 2
2,751	Lares	B 3
263	Las Marias	C 3
394	Las Piedras	C 10
1,021	Loiza	B 9
1,159	Luquillo	B 10
4,439	Manati	B 6
732	Maricao	C 2
952	Maunabo	D 9
16,563	Mayaguez	C 1
1,585	Moca	B 2
1,063	Morovis	C 6
3,303	Naguabo	C 10
769	Naranjito	C 7
645	Palo Seco	B 8
2,228	Patillas	D 9
1,042	Peñuelas	D 4
988	Playa, Humacao	D 10
35,005	Ponce	D 4
1,224	Quebradillas	A 3
308	Rincon	B 1
1,843	Rio Grande	B 1
3,084	Rio Piedras	B 8
2,636	Sabana Grande	C 5
1,857	Salinas	E 7
4,999	San German	D 2
48,716	San Juan	A 8
2,663	San Lorenzo	C 9
1,920	San Sebastian	B 2
1,290	Santa Isabel	C 3
905	Toa Alta	B 7
1,759	Toa Baja	B 7
573	Trujillo Alto	B 9
3,208	Utuado	C 4
1,667	Vega Alta	B 6
3,082	Vega Baja	B 6
3,158	Vieques	D 12
2,816	Yabucoa	D 10
6,589	Yauco	D 3


PORTO R
SCALES
Statute Miles, 12 = 1
0 1 2 3 4 5 10 15
Kilometres, 19 = 1
0 1 2 3 4 5 10 15 20
Rand McNally's 11 x 14 Map of
Copyright by Rand McNally
Longitude West
67°
66°30'
18° 30'
18°
17° 30'
1
2
3
4
5
6
A
B
C
D
E
F
G
H
I
A T L A N T I
C A R I B B
AGUADILLA
ARECIBO
MAYAGUEZ
PONCE
Aguadilla
Aguadilla Bay
Mayaguez
Mayaguez Bay
San German
Lares
Utuado
Ponce
Manati
Barceloneta
Yauco
Juana Diaz
Coamo
Guayanilla
Rincon
Cabo Rojo
Pt. Bruquen
Pt. Ensenada
Pt. Boca-prieta
Pt. Guaniquilla
Boqueron Bay
Pt. Melones
Aguila Pt.
Morrillos de Cabo Rojo
Light
Pt. Paso Jacinto
Pt. Isabela
Isabela
Pt. Borinquen
Muertos I.
Ratones I.
Frio Islands
Caja de Muertos
Guanica Pt.
Port Guanica
Port Guayanilla
Pt. Cuchara
Port Ponce
Port Salinas de Coamo
ISLANDS
WEST OF
PORTO RICO
On Same Scale as Main Map.
MONA PASSAGE
DESECHEO ISLAND
MONITO ISLAND
MONA I.
North Cape
Northwest Cape
Sardinera Anch.
West Point
Isabella Anch.
Light
East Cape
Playa Pajaro
Caigo o no Caigo Pt.
CARIBBEAN SEA
67° 30'
18°
Longitude West from Greenwich.
Pta. del Algarrobo
Algarrobo Reef
Mondongo Reef
Albert Bank
White Rock
Lights
MAYAGUEZ BAY.
SCALE.
Mayaguez
Marina
Pta. de Guanajibo
R. de Guanajibo
P O R
TO MAYAGUEZ
Cuchara Pt.
Arenas Cay
Ratones I.
CARIB



from Greenwich
66°
65°30'
7
8
9
10
11
12
13
A
B
C
D
E
F
G
H
I
18° 30'
18°
17° 30'
OCEAN
CARIBBEAN SEA
SAN JUAN
DE CABRAS Light
Pt. Salinas
Palo Seco
El Boqueron
Santurce
Cangrejos
Pt. Maria
Embarcadero de las Canoas
Maldonado Pt.
Lake Cangrejos
Lake San Jose
Rio Piedras
Pt. Pinones
Vacia Talega Pt.
Torrecilla
Mediana baja
Mediana alta
Herrera
Pt. Miquillo
Pt. Pesquera
Malade llano
Los Embarcaderos
Pt. Picadilla
Pt. San Diego
Light
LAS CUCARACHAS
Cape San Juan
CORDILLERAS REEF
Las Cabezas
Obispo
Palominas
Ramos
HERMANOS ROCKS
Hermanos Passage
BARRILES REEF
Barriles Passage
THE WASHER
Flamingo Bay
Surf Bay
CULEBRA I.
N.E. CAY
PALADA CAYS
Light
CULEBRITA I.
Ens. a Honda
Cactus Cay
Cross Cay
S. W. CAY
Culebra
Soldier Pt.
Pt. Figueroa
Port Medio Mundo
Pinerro I.
N. CABRAS I.
I. PUERCA
Pt. Puerca
CABRAS ISLAND
Bahia Honda
Pt. Algodones
Algodones Bay
Port Mula
Light
Vieques
Pt. Negra
PELICAN CAY
East Pt.
ISLA VIEQUES
Grand Port
Danes Bay
MAN OF WAR CAY
Port Ferro
Mosquito Bay
Sound Bay
Arenas Pt.
Mt. Pirata
Vaca Pt.
Bayamon
Frailes
Minillas
Sta. Rosa
Guaynabo
Camarones
Cupey
Carraizo
Mamey
Buenavista
Barrio nuevo
Dajos
Alto nuevo
Cedro
Gairoa
Buenas
Caguitas
Caguas
Gurabo
Rincon
Mulitas
Bayamoncito
Pina
Vegaredonda
Salto
Rio
Gordo
Abajo
Sidra
Sur
Arenas
Lapia lata
Culebras
Jaguas
Maloñabaja
Rincon
Cayey
Collado
Maton arriba
Cedro
Montellano
Pelado
Jajome bajo
Yeguas
Algarrobos
Patillas
Pueblo
Queb. Yeguas
Central Aguirre
Pozohondo
Guayama
Jobos
Arroyo
Cainita
Rico
Port Jobos
Pt. Pozuelo
Port Aguirre
Manchete
Guayama Bay
Arroyo Bay
Pt. Figuera
Light
Patillas Bay
Pt. Viento
Jacaboa
Portuguez Pt.
C. Mala Pascua
Light
Pt. Tuna
Naranjo Pt.
Yegua Pt.
Queb. arenas
Yabucoa
Guaraco
Guardarraya
Guallane Pt.
Guayanes
Pt. Icacos
Pt. Candeleros
Buenavista
Rio Abajo
Candelero
Humacao Playa
Pt. Santiago
Lima Pt.
Hucares
Pt. Naguabo
Humacao Cay
Mariana
Humacao
Asomante
Aguacate
Jacoa
Guayabala
Maton
Espino
Cerro Gordo
Cayaguas
Florida
San Lorenzo
Las Piedras
Celba
Rio
Naguabo
Boqueron
Penapobre
Duque
Queb. a Palma
Daguao
Ceiba
Saco
Fajardo
Dolmajagua
El Yonque
3,487 ft.
Jimenez
Guzman
Cubuy
Pitajaya
Lonias
Hato nuevo
Rio Grande
Hato viejo
Cienaga alta
Cienaga baja
Mameyes
Palmer
Sardinera
Luquillo
Trujillo
Trujillo Alto
Carolina
Guadanal
Barrasal
Hoyomulas
S. Anton
Sabana
HUMACAO
Lirios
Valenciano abajo
Hato
Cañabon
Caña Bonito
Tomas de Castro
Beatriz
GUAYAMA
Caliente
EXPLANATION:
Railroads
Roads
ATLANTIC OCEAN
CABRAS ISLAND
CABRITA I.
CADENA ROCKS
CADENA REEF
Morro Point
Light
CEMETERY
SAN JUAN
CASTILLO
STA. ELENA BATTERY
SAN AUGUSTIN BASTION
Canuelo Ft.
Palo Seco Pt.
Bonios Reefs
Bayamon River
Governors Castle
TABLAZO SHOAL
BARRIO DE LA PUNTILLA
CUSTOM HOUSE
ARSENAL
LANDING MCCLAINE
MATA REDONDA
ISLA GRANDE
San Antonio Channel
Yaboa Bay
Miraflores Bay
Miraflores Cut
CORAL REEFS
BARRACKS
Caguas
GAS HOUSE
St. George Channel
GERONIMO
MAGAZINE
Pt. del Escambron
S. Geronimo
El Boqueron
SAN JUAN
R. R.
CO.
San Antonio Bridge
PORT SAN JUAN
ANEGADO SHOAL
Simona Entrance
LONG SHOAL
MAGAZINE
GUARD HOUSE
Cataño Point
Landing
CATAÑO
Cataño Inlet
Cataño River
Bayamon Road
Guaynabo Road
PUEBLO VIEJO BAY
CAPITANEJA SHOAL
MONGANGA SHOAL
Martin Peña Inlet
Renta Inlet
Puerto Nuevo River
PORT SAN JUAN.
SCALE.
1 Mile
PORTO RICO
PONCE PLAYA
PORT PONCE
Peñoncillo Point
Carenero Point
GATAS ISLETS
CAYITO REEF
Light
CARDENAS I.
PORT PONCE.
SCALE.
CARIBBEAN SEA
O RICO
SCALE
20
25
30
35

are ranged in two nearly parallel lines with intervening tablelands and high valleys, crosses the island from west to east, culminating in the peak called El Yunque (3,700 feet) in the northeast. Lower transverse ridges, running northward and southward from the principal chain, sink into the wide plains which border the coasts, forming a large number of pretty scenes and valleys. The eastern and northern slopes, valleys and plains receive an abundant rainfall through all the year, while the regions on the other side of the mountains are often parched by drought. The mean temperature at San Juan ranges in different years from 78° to 82° F., the maximum on record being 99° and the minimum 57° F. The climate of the highlands, where the mean annual temperature is 72° F. or less, is very agreeable all the year, although it contains an excess of moisture at some points. (See also paragraph *History* for statement in regard to hurricanes). The island is well watered. Streams are uncommonly numerous, and some of them are navigable for small craft near their mouths. On the north coast 17 rivers flow into the sea; on the east coast, 9; west of Cape Mala Pascua on the south coast, 16; on the west coast three, beside the outlets of several freshwater lakes. There are several falls of considerable size, the largest being Comerio and Rio Blanco falls. Harbors are those of San Juan, Culebra, in the island of Culebra (at both of which United States naval stations are established), Guánica, Hobos or Jovos, Guayanilla and Ensenada Honda.

Mineral Resources.— It is certain that large quantities of gold were found in the alluvium deposits during the early years of Spanish occupation; it seems probable, therefore, that lodes of gold-bearing quartz or conglomerate will be discovered in the central range from which the streams issue. A systematic geological and mineralogical survey is required. Casual explorations have shown the presence, in several places, of magnetic and specular iron in large quantity, especially in the eastern part of the island; copper, agate of good quality, garnet, malachite, manganite, etc. Here, as throughout the Antillean regions (see CUBA and CENTRAL AMERICA), the older metamorphic rock and conglomerates, even on the summits of the mountains, are covered with limestone formations.

Flora and Fauna.— The island was once covered with a beautiful virgin forest, but unfortunately "Forestry regulations," according to Robert T. Hill, "have not been more wisely observed in Porto Rico than elsewhere in the West Indies"; however, in the highlands the conditions, both in soils and climate, are favorable to vegetation. The trees, which are noteworthy on account of their size or beauty, are the several species of palms and tree-ferns, tillandsia, *Cocobola macrophylla*, lobelia, etc. Useful woods are the ausubo, cedar, aceitillo, mahogany, laurel, West Indian sandalwood, ebony and willow and a large variety of dyeing wood. Trees producing edible fruits and plants valuable medicinally are especially numerous. The fauna includes no indigenous quadrupeds; there are no beasts of prey or wild animals of any kind, and unlike the Caribbees, or the tropical continent, Porto Rico is not infested by poisonous snakes and other noxious reptiles, though centipedes and the tarántula are not unknown. There is a large variety of bees. Birds are multitudinous and are noted both for their fine singing and beauty of their plumage; they include the canary-bird, humming-bird, nightingale, parrots and doves. The tortoises of the island are said to be closely allied to those of the Galapágos Islands (q.v.). Some of the rivers are well stocked with fish, and the fisheries, on the north coast especially, are valuable.

Agriculture, the Fruit Industry, etc.— — Compared with that of the other West Indian islands, Porto Rico's agriculture is remarkably diversified, the chief products being sugar, tobacco, coffee, pineapples, grape fruit, oranges and other tropical fruits, sea island cotton, textile fibres, bat guano, phosphate and vegetables. The sugar crop for three years was as follows: 1915, 488,943 tons; 1916, 483,589 tons; 1917, 502,390 tons. Sugar exported in 1917 amounted to 488,943 tons, valued at $54,015,903, being over 66 per cent of all exports of the island. When the Americans occupied the island there were 250 sugar mills and about 20 centrals. The latter have been increased in number as well as in capacity, due to the protection enjoyed by Porto Rican sugar in the United States markets, while the old-fashioned mills are gradually disappearing by their constant conversion into modern centrals. Next to sugar the tobacco industry takes the lead. But although the number of acres of land dedicated to tobacco has increased by tenfold during the last 20 years, and the quality has been much improved, it may be safely stated that the industry has not yet attained its full development. The cocoanut industry is also very promising; the farmers dedicate more land to it steadily, and better attention is paid to the selection of seed. At present hundreds of acres are dedicated to cotton, and much effort is being made by merchants of San Juan to encourage farmers to increase the acreage as well as improve the quality. There is a ginnery in San Juan. Before the American occupation the oranges and pineapples of Porto Rico were famous for their flavor and sweetness, but they grew wild and in such small quantity that seldom were they exported. Since then, however, the fruit industry has undergone such a favorable change, that while the number of acres dedicated to oranges or pineapples has not been exactly estimated, yet the former are now shipped to the United States in large quantity and in 1917 more than $900,000 worth of pineapples were exported. It may be safely asserted that the fruit industry will be the future industry of this island, as roads are built and better transportation facilities are offered to shippers. Rice, corn, bananas and beans are also raised, but not in sufficient quantity for export trade. Cattle-raising is an important industry, the best pastures lying on the northern and eastern slopes.

Commerce.—The exports of sugar are given above under AGRICULTURE. In 1917 210,399,365 cigars and 9,571,250 cigarettes were exported. Over 9,000,000 pounds of leaf and scrap tobacco, valued at $3,850,670, were exported in 1917. The coffee crop, which in 1916 amounted to 32,144,283 pounds valued at $5,049,283, reached 39,615,146 pounds in 1917 with a value of $5,892,081. In the same year oranges to the value of $1,009,737 were exported; fresh pineapples to the value of $916,415; canned pineapples to the value of $139,765; grapefruit to the value of $939,677; and cocoanuts to the value of $438,564. The total imports of 1917 aggregated $53,545,224; domestic exports to foreign countries amounted to $7,855,693. United States goods to the value of $49,539,249 were shipped to Porto Rico in the same year and foreign merchandise to the value of $4,005,975. Porto Rican shipments to the United States in the same year were valued at $73,115,224.

Manufactures.— The chief industries of the island are manufactures of cigars, cigarettes, hats, embroiders, drawn-work, rum, etc. According to the last census there were on the island 939 industrial establishments, employing 18,122 persons, of whom 15,582 were wage-earners, having a total capital of $25,544,385, with an output valued at $36,749,742; of these there were 108 establishments connected with the sugar and molasses industry, employing 5,062 wage-earners and having an annual product valued at $20,569,000; there were 282 tobacco establishments employing 7,025 wage-earners, with annual products valued at $6,060,000. Other classes in order of their importance were bakeries and bakery products, boots and shoe factories, printing and publishing, lumber and timber products, etc.

Railways and Roads.— The undertaking to encircle the island with a railway dates from 1888. By 1892 there had actually been built 119 miles. There are now over 1,100 miles of road in the island and about 300 miles of railway. The railway system connects towns on the west coast and now almost encircles the island and penetrates the interior. A line is operated from Rio Piedras to Caguas inland. Extensions of existing lines are being undertaken and a new line across the island, with many branches, is projected. There are 80 post offices and 73 telegraph stations, 1,544 miles of postal telephone and telegraph wire. Passenger and freight lines connect Porto Rico with the United States, Cuba, Panama, France, Spain and other countries.

Finance.— The annual budget of the island has varied from three to four millions of pesos, aside from city budgets. This budget included from 1,250,000 pesos to 1,500,000 pesos which the Island contributed to the national expense, under the subheads of Ministries of Colonies, War and Navy. In 1909 no appropriation bill was passed and Congress continued the appropriation of 1908.

The budget for 1898-99 (the first year under the home rule system) showed expenditures of 4,446,952 pesos and income of 4,782,500 pesos. The first budget under the civil government established by the Foraker Act was about $2,000,000 (expenditure); that of the year 1906 about $2,500,000 (expenditure). The main source of income under the Spanish rule was from custom duties on imports and exports, especially on sugar, as up to 1901 there was no regular system of taxation in the island. Porto Rico, however, was always able to meet its budget and besides have a surplus in its treasury. It is from this surplus that Spain drew $2,000,000 to fight the Cubans in 1895-96. This money was lost to the island. The taxable property of the island at present is valued at $182,622,164. The present sources of revenue are customs and excise, general property tax, collateral inheritance tax, taxes on insurance companies and from various licenses and fees. The treasury statement of 1 July 1917 is as follows:

Balance, 1 July 1916	$2,910,648
Receipts, 1916-17	10,937,947
	$13,839,595
Disbursements, 1916-17	9,733,750
Balance, 1 July 1917	$4,105,845

The bonded indebtedness amounts to $9,280,000.

Porto Rico has had several currencies. The macuquina, which was introduced in the island as early as 1800 from Venezuela, was the legal tender up to 1857. This currency was very imperfect; it consisted of pieces of solid silver and copper, irregularly cut, bearing a poor imitation of the Spanish coat of arms and had a discount of 12½ per cent on the Spanish national currency. To withdraw the macuquina money the Spanish government sent to the island 1,350,000 Spanish pesos, the island losing 215,466 pesos, which was necessary to cover the difference in value. In 1867 the island of Santo Domingo having gained its independence, its money, known as calderilla, was brought to Porto Rico. The same year a royal decree allowed the free circulation of foreign money in the island, fixing a relative value on the basis of the Spanish legal tender. This measure brought abundance of money into the island. In 1879 a royal order made the Mexican peso the official currency, given it a value of 95 cents American money; and another royal order in 1881 authorized its free circulation. In 1895 the government ordered the exchange of the Mexican money for what was called the “special currency”; 6,426,393 pesos were thus exchanged, at a cost to the island of $1,210,000 for recoining, transportation expense, etc. This special provincial money was finally exchanged for the American legal standard at a discount of 66⅔ per cent.

Banks.— These institutions were unknown in Porto Rico up to 1888, in which year the Spanish Bank (known now as the Porto Rico Bank) was organized, but not opening its doors until February 1890; capital 1,500,000 pesos, 750,000 paid up; in 1898 it had issued notes to the extent of $2,587,445; head office in San Juan. The Banco Territorial-Agricola (Agricultural Bank) was established in July 1894; capital 2,400,000 pesos; head office in San Juan. The Banco Popular was also organized in 1894 with a capital stock of $18,000; head office in San Juan. The Crédito y Ahoro Ponceño (a savings bank) was organized in November 1894, with a capital stock of $200,000; head office in Ponce. American Colonial Bank was established in 1899 with a capital stock of $400,000; head office in San Juan. National Bank, branch in San Juan, Porto Rico, opened in 1902 with a capital stock of $100,000. Union Bank of Halifax, in San Juan, with a capital stock of $1,500,000, was established in August 1906. There are now 15 banks with combined capital aggregating $2,250,000, deposits over $12,000,000.

Population.— On 14 Dec. 1910 the number

PORTO RICO

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San Juan

PORTO RICO

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1 Porto Rican Tobacco Fields

2 Harbor of San Juan

of inhabitants was 1,118,012 (consisting principally of whites, mulattoes, negroes and Chinese). It is to be observed that while the census taken in 1887 shows a black population of 76,985, and that taken in 1897 reduces the figure to 75,824, the census of 1899 further reduces the figure to 59,390. If this decrease should continue for a number of years, the black race would eventually disappear from Porto Rico, unless there is an immigration of that race from the other West Indian islands in the future. This is the only island in all the West Indies where the white population is so overwhelmingly in the majority. At the last census there were 50,245 negroes and 335,192 mulattoes, 732,555 whites and 20 Chinese. In 1910 the colored population was 35 per cent of the whole. The estimated population in 1914 was 1,184,489. Of the working population 63 per cent are engaged in agriculture, fisheries and mining; 21 per cent in domestic and personal service; 8 per cent in manufacturing industries and 8 per cent in trade and transportation. The percentage of illiteracy which was over 83 per cent in 1899 has been reduced to 66.5 per cent. The white population was divided into three classes: (1) the aristocracy of the country, not seldom colonial branches of excellent families of Spain; (2) trades-people in the towns; (3) a peasantry plagued with anæmia, the so-called *jíbaros*, of whom Mr. van Middeldyk says: «Intellectually the *jíbaro* is as poor as he is physically. His illiteracy is complete.» But the *jíbaro*, it must be admitted, has had hard luck. The descendants of the early Spanish colonists and in the majority of cases of the Indians, they retained the superstition of the former and a little of the natural timidity and reserve of the latter. These atavic traits, added to the fact that they have been robbed and deceived by the Spanish merchants, who took advantage of their ignorance, reducing them to a sort of serfdom worse than slavery, have made them what they are to-day, a physically degenerated class with no ambition whatever. They are, however, naturally bright and generous, and once you have gained their confidence, dispelled their mistrust, they are most hospitable and loyal. Above all they love peace and fear the law. Education, which they never had a chance of getting, and the development of the interior, will improve their way of living, awake their dormant intellect and redeem them from their present debased condition.

The members of the first class who were rich and could receive a liberal education went to Europe or the United States, where they would become lawyers, physicians, engineers, etc., and return to their country to practise their profession. Those who were poor were compelled to remain home, contented with what knowledge could be acquired in a very reduced number of public schools, a normal school and a high school in San Juan (where the degree of bachelor of arts could be obtained); the second and third classes did not receive any education at all, except in rare cases, no efforts being made by the government to raise the standard of education either by making it compulsory or by furnishing sufficient public schools, the number never exceeding 124 and the system being extremely antiquated.

Education.— In 1899 only 16 or 17 out of 100 Porto Ricans could read and write. Under the new government the number of schools was increased to 1,104; local authorities were required to provide suitable school buildings; primary instruction was made compulsory; and existing institutions of higher education were supplemented by normal, trades and high schools. In 1917 there were 1,666 school buildings, with 115,000 pupils enrolled; and a well-distributed system of night schools and kindergartens. There are also a number of private schools. The University of Porto Rico, established in Rio Piedras, near San Juan, is coeducational. There are 41 school districts on the island, each under a supervising principal, who is appointed by and represents the Commissioner of Education. There are local school boards of three elected for terms of four years by popular vote.

History and Government.— On 19 Nov. 1493 Columbus landed on the western coast, and named the island San Juan Bautista. On 14 Aug. 1509, Juan Ponce de Leon, who had discovered gold on the island, was appointed governor by King Ferdinand. The natives, who called their island Borinquén, and had chiefs of their own, were enslaved and forced to work the placer deposits. In June 1511 the Indians slaughtered about one-half of the Spanish force, but were reduced to submission. The aboriginal population at that time probably numbered from 80,000 to 100,000 (not 600,000 — an estimate often repeated, but resting upon a wholly unwarranted statement in Friar Abbad's 'Historia'); on 27 April 1515 Counselor Sancho Velasquez wrote to the king that, excepting the Indians assigned to the royal estate and those of the Crown officers, «there are not 4,000 left.» The greater number of the natives perished; some poisoned themselves; others emigrated to the neighboring islands — so cruelly were they treated — and the rest gradually blended with the invaders. About this time it became customary to refer to the capital as «Puerto Rico,» instead of Capárra. Thus modern usage precisely reverses the original intent; for the name Columbus gave to the island is applied only to its chief town, while the name by which Ferdinand designated the settlement on the northern «port» has supplanted both «Borinquén» and «San Juan Bautista.» On 26 Feb. 1521 Ponce de Leon sailed on his second expedition to Florida. Again disappointed and repulsed, he did not return to Porto Rico, but sought refuge in Cuba, where he died. On 18 April 1533 the authorities of the capital petitioned the empress against the further introduction of African slaves. It appears from a letter written by Governor Lando to the emperor in 1534, that very few negroes had been sent to the island up to that time; but a few years later they arrived in large numbers, taking the place of the Indian laborers. Palm Sunday 1554, the principal settlement on the south coast was destroyed by a landing party from three French ships. On 22–25 Nov. 1595 Sir Francis Drake, commanding a strong fleet, attacked San Juan. That port was well defended and the English withdrew. Two years later a large body of English troops, under the Duke of Cumberland, occupied San Juan, then garrisoned by a small body of troops, for a few months. From 25

Sept. to 2 Nov. 1625 San Juan was besieged by a Dutch fleet; landing was effected, but the besiegers were compelled to withdraw with heavy losses. The city was under the command of Don Juan de Haro. From 1640 to 1780 expeditions were equipped in Porto Rico for the long struggle with the buccaneers. In 1702 some English troops landed at Arecibo, but were defeated by a body of militia under Captain Correa. On 17 April 1797 an English fleet, 15 ships and several transports, under Admiral Harvey, with troops commanded by Sir Ralph Abercromby, numbering over 6,000 strong, appeared before San Juan; the city was under the command of Don Ramón de Castro, who gathered with him among regulars, militia and volunteers, about 4,000 men. The forts were manned by Frenchmen, then the allies of the Spaniards. The invading force landed back of the city by the place known as Cangrejo, and marched on to the city, but before they came to the San Antonio bridge, they met such strong resistance, both from the infantry and artillery on the forts, that they were compelled to reembark, apprehending an attack from the rear, with great losses both in war materials and men. The ineffectual siege was maintained only 15 days. This attack and that made by the Dutch in 1625 are perhaps the most important events in the history of the island since the conquest from a military standpoint. To the city, as a reward for gallant resistance at this time, was granted the privilege of adding the words «very noble and very loyal» to its coat-of-arms. Loyalty was strikingly evinced early in the following century. On 20 Dec. 1819, in February 1825 and November 1829 expeditions from Colombia landed in Porto Rico, to encourage the inhabitants to rebel against Spain; they were not welcomed. Nevertheless, in 1837, Porto Rico was deprived of the right of representation in the Spanish Cortes, which she had since 1808, as a result of the advent of Ferdinand VII to the throne. During half a century the captains-general as a rule favored a systematic demoralization of the common people. «While they dance and gamble, they will not conspire,» said one of these pernicious governors. Another means by which the government encouraged the demoralization was by promoting and giving good offices to those of the natives who would be traitors to their country by denouncing imaginary conspiracies and revolutions. But one fact about this little people is that, while they feel proud of their Spanish ancestry, yet neither money nor threats could ever win an intellectual Porto Rican to serve the cause of tyranny. On 20 Sept. 1868 the «insurrection of Lares» broke out — an insignificant rising, quickly suppressed. The plan was to follow Cuba, which island was then struggling to throw off the Spanish yoke. Dr. Betances, the leader of this movement, escaped to the neighboring island, and then went to live in exile in Paris, where he died some 30 years later, never forgetting his little island, and never forgotten by those whom he once dreamed he could free. As one result of the revolution of that year in Spain and the subsequent establishment of the republic, Porto Rico was again permitted to send representatives to the Cortes. On 22 March 1873 the slaves in Porto Rico were manumitted, 31,000 receiving freedom in a single day. The slaveholders were paid in government bonds, which a foreign syndicate bought up at 15 per cent. Then followed a period of political unrest with the restoration of the monarchy, marked by abuses of all kinds committed by the officials sent by Spain. By this time, 1873-74, political parties were organized following the line of the Cuban reform party and later (1886) the Home Rule party. This movement on the part of the Porto Rican patriots brought about in 1887, under General Palacios, what is called the «Componte» era, when the people were tortured by the mounted police (*Guardia Civil*), and the most honorable citizens were thrown into the dungeons of «El Morro» and barely escaped being shot. This is perhaps one of the darkest periods of the colonial history of the island. By the end of 1896 the Porto Ricans again began to feel the influence of the Cuban ideas, and the western part of the island showed a disposition to revolt, and might have done so if some one of the Porto Ricans who had gained honor and renown in the Cuban War had landed to lead them. But as a rule the Porto Ricans are a peace-loving people; they at all times preferred to gain what liberties they could bargain from Spain by means of the press and other means of propaganda, rather than resort to arms. It was about this time that some prominent citizens from Camuy were imprisoned and tortured and everything indicated that the horrible scenes under General Palacios were to be once more repeated under General Sabás Martín. It was now, however, too late for this, for although the Spaniards never doubted that they would ultimately come out victoriously from a conflict with the United States, nevertheless a little apprehension as to the future made them more humane and cautious in their treatment of defenseless Porto Ricans. On 25 Nov. 1897 the royal decree conceding autonomy to Porto Rico was signed.

After 400 years of a military government of a most absolute character, Porto Rico finally secured what is called an Autonomic Constitution, which gave the island a Parliament consisting of a senate of 15 members, eight of whom were elected by the people and seven appointed by the Crown; and a lower house, consisting of one representative for every 25,000 inhabitants. The system also provided for a body of five ministers,— Minister of Justice and State (Gracia, Justicia, y Gobernacion), of Finance, of Education, Public Works and Roads, and of Agriculture, Industry and Commerce,— appointed by the governor, thus practically providing for the separation of the three powers. The power of veto was retained by the government at Madrid. It has been asserted by the natives that this measure of home rule fully satisfied their ambition. Notwithstanding it has often been set up against this law that it was not in good faith, and was not to stay, being only a measure of war and a trick of Spain to induce the Cubans to lay down their arms. It is probable that the law was so intended; those, however, who so speculate seem to forget that colonizing nations never granted any degree of liberty to their colonies, except they were compelled to by the force of circumstances; but no one will question the fact that once Spain had granted to her colonies in America a liberal form of government, she could never have been able to restore on this side of the ocean her 16th century régime. This self-government, however, was of short duration, for a few months after the elections, 21 April 1898, Governor-General Macias suspended the constitutional guarantees and declared the island in a state of war. On that day war began between the United States and Spain, though not formally declared until the 25th. On 12 May 1898, the capital was bombarded by Admiral Sampson, only a few buildings being damaged and probably a dozen casualties. On 25 July 1898 American forces occupied Guanica; three days later Ponce; on 10 August skirmishes took place at Hormigueros and Guamani, on the west and southeast parts of the island, and on 12 August at Las Marias, on the west, and near the Asomante, on the Ponce road. On 12 Aug. 1898 the protocol was signed providing for the cession of Porto Rico, etc., to the United States; 18 Oct. 1898 the last of the Spanish troops to sail embarked for the peninsula; the forces of the United States occupied San Juan, Maj.-Gen. John R. Brooke taking up the duties of military governor. His successors in that office were: on 6 Dec. 1898, Maj.-Gen. Guy V. Henry, and 18 May 1899, Brig.-Gen. George W. Davis. This government is noted in the history of Porto Rico for its mildness and wisdom. On 8 Aug. 1899 a hurricane, accompanied by excessive rainfall, devastated the island, 3,369 persons being killed outright, while thousands died from starvation. The army distributed 32,000,000 rations to the sufferers. Disasters of this nature have befallen Porto Rico, although probably never so severe, more than 20 times since the year 1515, occurring most commonly in July, August and September. On 12 April 1900 an act of Congress required that there should be established for Porto Rico a modified territorial form of government, consisting of executive, legislative and judicial branches. For the benefit of such government a tariff of 15 per cent was imposed on imports from the United States into Porto Rico, and vice-versa. On 1 May 1900 civil government was inaugurated, having the following general features: Governor, appointed by the President of the United States; legislative assembly, consisting of an executive council or senate appointed by the President (six Americans and five Porto Ricans), and a house of delegates (35 members elected by the people); judiciary, including Supreme and United States District Courts. The first governor was Hon. Charles H. Allen. His successor, 15 Sept. 1901, Hon. William H. Hunt; 25 July 1901 the President proclaimed cessation of tariff duties between Porto Rico and the United States. On 2 Dec. 1901 the Supreme Court of the United States decided that Porto Ricans were not *ipso-facto* citizens of the United States. In December 1902 the insular treasury had on hand a considerable balance from revenues produced by the system of local taxation enacted by the legislative assembly. On 4 July 1904 Beekman Winthrop took the oath of office as governor; followed by George R. Colton. Mr. Colton was succeeded by Arthur Yager in 1913. The present constitution is determined by the "Organic Act" of 1916, the main features of which are the granting of American citizenship to the people of Porto Rico, the separation of the legislative and executive departments, extension of the appointive judiciary system and an elective senate. The franchise is restricted to citizens of the United States 21 years of age or over, residence of one year and such additional qualifications as may be prescribed by the legislature, but no property qualification may be imposed. The governor is appointed by the President of the United States. The senate is composed of 19 members and the house of representatives of 39 members. The island is represented in the United States Congress by a resident commissioner elected for four years. Six heads of departments form a council to the governor.

There are two political parties in Porto Rico, both working to change the status of the island; one, which is called the Republican party, with a marked tendency for Americanization, wants the island to become a State of the Union, and the other, the Unionist party, with a platform advocating either home rule under a colonial government, statehood or independence. In one point both parties agree, and that is that the upper house, which is now appointive, should be elective, at least a majority of it.

Literature, History, Arts.— Porto Rico has a considerable literature. It is not very intense or varied, but it has originality. *Poets:* The natural beauty of the country, its exuberance, and the despotism to which it has been subjected, have fostered poetic production, the genre of literature more successfully cultivated. Among the poets who flourished between the years 1860 and 1880 are José Gauthier Benitez, of exquisite sensibility, a Lamartinean melancholy and a rare sense of beauty; and José G. Padilla, better known as the "Caribe," a brave heart, who gave vent to his patriotic indignation in vigorous and well-rhymed stanzas. Decadence set in after the death of these two poets. There are, however, some younger poets of considerable talents, among who may be mentioned J. de Diego, Lola Tio, R. del Valle, J. Gordil, Negron Sanjurjo, F. Cestero, E. del Toro, Negron Flores, and F. G. Marin who was killed in Cuba fighting for the cause of liberty. *Historians* (local): By the middle of the 19th century Alejandro Tapia published his 'Biblioteca Historica de Puerto Rico'; later J. Julian Acosta published a revised and commented edition of the 'History of Porto Rico' by Fray Iñigo Abbad; and among the contemporary authors we have Salvador Brau and Drs. Stahl and Coll. *Orators:* Manuel Corchado, who died while still young (1840–84), has been perhaps the most eloquent orator produced by Porto Rico. His brilliant speeches in behalf of the liberties of his country are still remembered. He was also a poet and writer. Among the orators of the day are J. Hernandez Lopez and R. Matienzo Cintron, both powerful and brilliant, good specimens of the best parliamentary speakers, and Alvarez Neva, a powerful forensic orator. *Journalism:* This was the means chosen by the Porto Ricans to contest the Spanish oppression from the middle of the 19th century. This journalism, however, is not as it is understood in the United States; it is more of doctrinal and polemic character; but reporting is gradually creeping in, and we may say that the influence of modern ideas in Porto Rico is nowhere better manifested than in the field of journalism. Among the ablest newspaper men of the day are L. Muñoz Rivera, Dr.

Zeno Gandoa, Manual Rossy and Matos Bernier. *Music:* The higher order of music is not cultivated in the island, so far as production is concerned; there are, however, some clever composers of «danza,» a dancing piece, a sort of a rondo andante which, being exceedingly graceful and melodious, evinces better than anything Porto Rican the nature and sensibility of this people. *Painters:* Campeche and F. Oller.

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PORTO RICO, University of, an institution for the promotion of higher education, created by an act of the insular legislature which was approved 12 March 1903. The president of its board of trustees writes that one of the first acts of the «army officers» during the occupation of the island by military forces of the United States at the close of the Spanish-American War was the establishment of a normal school. (For the need of instruction, and of teachers to give it, see PORTO RICO: *Population and Education*). That school was located at Fajardo on a site of 80 acres given for the purpose by the citizens of that town. It soon became evident, however, that a more central location was required, and, therefore, in 1901 the school was transferred to Rio Piedras. When the university was founded (1903) the normal school with its land, etc., passed under the control of the university board of trustees and became the first department of that institution to be put into full operation. In its building and equipment the normal department has enjoyed the liberality and interest of the people of Ponto Rico. Its growth has been steady. At the April 1913 meeting of the board of trustees of the university resolutions were passed creating a college of law, college of pharmacy, university high school and extending the course of the college of liberal arts to four years, giving authority for the granting of the degree of bachelor of science or bachelor of arts upon the satisfactory completion of this course. The college of liberal arts had, indeed, been legally constituted since 1911, but no particular effort had been made to attract students. The president of the University of Porto Rico states that the act of 12 March 1903 vested authority in a board of trustees composed of 11 members; that the bond of connection between this new university and the Department of Education was preserved through the appointment of the commissioner of education as president of the board of trustees and chancellor of the university, ex officio; and that «except for this connection, the university is an independent and separate department of the insular government.» The same act gave the board of trustees power to establish new departments and the right to confer degrees. Subsequently the number of members of the board of trustees was reduced from 11 to 7, the governor appointing four while the remaining three, namely, the commissioner of education, the treasurer of Porto Rico and the speaker of the house of delegates, are ex officio members. The work of that department known as the college of agriculture and mechanic acts, at Mayaguez, was begun in 1912. Consult Annual Reports of the Governor of Porto Rico (in Annual Reports, War Department, Washington).

PORTO RICO EXPEDITION, Military and Naval Society of the, an association projected at Caguas, Porto Rico, 11 Oct. 1898, and formed at Columbus, Ohio, 5 June 1900, to bring into permanent relationship the men connected with the military and naval operations during the Spanish-American War which led to the acquisition of Porto Rico by the United States. There are three classes of members, active, associate and honorary. The active members comprise those officers and enlisted men in any branch of the United States service who accompanied the Porto Rico expedition and were on the island on or before 18 Oct. 1900, the day when the American flag was raised over the Capitol at San Juan. The associate members are those soldiers or sailors of good reputation who were attached to organizations or vessels which composed the expedition but who, through sickness, disability or by assignment to other duties, were detained in the United States and failed to actively participate in the expedition. Members of the Red Cross Society, volunteer nurses and others who served with the army in Porto Rico may also become associate members.

PORTO SANTO, pōr'too sän'too, one of the Madeira Islands, 26 miles northeast of Madeira (q.v.). Its area is about 20 square miles. It is six to eight miles in length, two to three in breadth and not more than 500 feet above sea-level, though the surface is rugged and hilly. It is of volcanic origin, and almost destitute of trees. The soil is poor; the only productions are limestone, maize, barley, vegetables, a few fruits and a poor kind of wine. Its capital, La Vilha do Porto Santo, on a handsome bay with a good harbor, protected by a battery, is frequented by vessels going to and from the Cape of Good Hope. Pop. of island about 1,600.

PORTOBELLO, pōr-tō-bĕl'ō, Scotland, a suburban watering-place of Edinburgh, three miles to the east, on the Firth of Forth. Its first house was built in 1742 by one of Admiral Vernon's officers, in the expedition against Puerto Bello, whence its name, but its progress dates like that of its east extension, Joppa, from 1804. It has some manufactures of glass, pottery, bricks, etc., and is fully equipped with the usual accompaniments of a popular summer sea-bathing resort.

PORTOVIEJO, pōr″tō-vē-ā-hō, Ecuador, the administrative seat of Manabi Province, 100 miles north of Guayaquil. It was founded in 1534, and was frequently captured and destroyed by buccaneers. It has manufactures of straw hats.

PORTRAITURE. See PAINTING; PHOTOGRAPHY.

PORTSEA, pōrt'sē, England. See PORTSMOUTH.

PORTSMOUTH, pōrts'mŭth, England, the principal naval station of Great Britain, a seaport and municipal and parliamentary borough, in Hampshire, on the southwest extremity of Portsea, 68 miles southwest of London by rail.

The island of Portsea is bounded on the east by Langston Harbor, on the west by Portsmouth Harbor, and on the south by the roadstead or channel of Spithead, across which is the Isle of Wight; it is separated from the mainland by a narrow creek called Portbridge Canal. It consists of the four districts, Portsmouth proper, Portsea, Landport and Southsea, these being now more extensive than the towns to which they belong. The towns, united so as to form a fortress, are protected by one of the most extensive modern systems of fortifications, which have replaced the former moats, walls, and ramparts, entered by four gates, one of them designed by Inigo Jones. Landport and Kingston are adjacent to Portsea on the north, and Southsea, on the east side of the town of Portsmouth. The two first-named districts are for the most part occupied by artisans connected with the royal naval dockyard in Portsea. A fine park, the Victoria, is in a conveniently central situation. Southsea is one of the favorite English seaside resorts. Its situation commands fine views of the anchorage at Spithead, and of the Isle of Wight. Southsea common, which extends down to the beach, forms a fine public recreation ground, and on it troops from the neighboring garrisons are often assembled for field days and reviews. Southsea Castle with its adjacent earthworks, the batteries of the Gosport side, and the circular forts in the roadstead, command the entrance to Portsmouth Harbor. The town of Gosport on the opposite side of the harbor entrance is connected with Portsmouth by a floating bridge ferry.

The best street in Portsmouth is the High street, which divides the town into two nearly equal parts and contains the principal shops, hotels and places of business. The prominent public buildings include Government House, the splendid new town hall opened in 1890, the post office, the grammar school, Athenæum, Theatre, hospital, Sailors' Home, Central Railway station, the parish church (Saint Thomas à Becket's), built about 1170, the Roman Catholic cathedral with schools adjacent, the Presbyterian Church, the Independent Chapel in King street, and numerous other places of worship.

The royal dockyard, which has been extended by the addition of new docks and basins, covers an area of about 500 acres. It is enclosed by a wall 14 feet high, and entered by a lofty gateway. It includes vast storehouses, machine-shops, extensive slips and docks, ranges of handsome residences for the port-admiral and other officials, etc. Outside the dockyard an area of 14 acres contains the gunwharf, where vast numbers of guns and other ordnance stores are kept; and there is an armory with 25,000 stand of small arms.

Portsmouth has no important manufactures except those connected with its naval establishments, and a few large breweries. Its trade, both coasting and foreign, is of considerable extent; the former consisting chiefly of coals from the Welsh and Newcastle coal fields, cattle and sheep from the Isle of Wight and the west of England, and large quantities of corn and provisions from Ireland; and the latter of wine from different parts of the Continent, eggs from France, and timber from the Baltic.

Portsmouth is mentioned in the *Saxon Chronicle* as existing in 501. It appears to have taken the place of Porchester, which as *Portus Magnus* had been selected by the Romans for a naval station, but became unfit for that purpose in consequence of the silting of the harbor. During the reign of Alfred a fleet of nine ships fitted at the port defeated the Danes, who had long infested the coast; and immediately before the Conquest a large fleet was fitted out here to intercept the Norman armament. About 1256 Henry III assembled an army here for the invasion of France. In 1377 Portsmouth was attacked by the French, who succeeded in burning a part of the town. This disaster appears to have shown the necessity of fortifying the place, and the works, commenced by Edward IV, were much improved and extended during succeeding reigns. The town was taken by the Parliamentarians in 1642. The *Royal George* battleship in 1792 heeled over and sank in Portsmouth Harbor, drowning nearly 1,000 persons. Pop. about 231,141.

PORTSMOUTH, N. H., city, one of the county-seats of Rockingham County, on the Piscataqua River near its mouth, and on the Boston and Maine Railroad, 57 miles north of Boston. It was first settled in 1623 by a company under the direction of Fernando Gorges, and was under the jurisdiction of Massachusetts until 1679, when New Hampshire became a separate colony. It was incorporated as a town in 1653, when it received the name of Portsmouth, and became a city in 1849. It was the capital of the State for some time, and is now alternately with Concord the seat of the sessions of the United States District Court of New Hampshire. It is built on a peninsula, and has an excellent harbor, deep, well sheltered and always free from ice; it is the only seaport in the State, yet has practically no foreign commerce, but a considerable coasting trade, particularly in coal. Over 1,000,000 tons of coal are shipped annually to Dover, Concord, Manchester and other inland cities. The harbor is protected by earthworks at Jaffrey's Point and Gerrish's Island. The manufacturing establishments are important; they include boot and shoe factories, cotton mills and marble works, button works, tanneries, foundries, oil refineries, lumber yards. Shipbuilding was formerly an important industry, and small vessels are still built. The industrial output of the city is valued at $3,000,000 yearly. It has railroad and trolley connection with York Beach, Hampton Beach, and other popular summer resorts; and, in the summer, daily steamboat connection with the Isles of Shoals. It is a quiet city and old-fashioned in appearance, containing many colonial houses of historic interest; chief among these are the Wentworth house, the Warner house, the Moffatt house, the Pierce mansion and the Langdon house. Other buildings of note are the Saint John's Church, the North Congregational Church, the Federal custom house, the Athenæum, the Rockingham County courthouse, the Portsmouth Hospital, the three national banks, two savings banks and the trust company. The latter has a library of over 25,000 volumes, and there is also a public library of 20,000 volumes. The city contains a Home for Indigent Women, a Home for Children and other charitable institutions. The navy yard, which is officially known as the Portsmouth navy yard, is situated on an island of the Piscataqua (formerly known as Fernald's Island), within the limits of the township of Kittery, Me. It has large drydocks and in the days of wooden ships many were built here including the *Ranger* and the *Kearsarge*. For many years the historic frigate *Constitution* was kept at this navy yard, until taken to Charleston. In 1898 the Spanish prisoners from Cervera's fleet were brought here and given comfortable quarters on a small island connected with the navy yard island. The treaty ending the Russo-Japanese War was negotiated at Portsmouth in the «Peace Building,» on Leavey's Island. There are three public parks, Langdon, Haven and Goodwin. There is a statue of General Porter in Haven Park and a Soldiers and Sailors' Monument in Goodwin Park. There is also a large public playground. The city government is vested in a mayor, who holds office for a year, and a legislative council. The police commissioners are appointed by the State. The waterworks are under municipal management. Pop. 11,602. The city claims among her illustrious sons Gov. Benning Wentworth, his nephew, Gov. John Wentworth, Gov. John Langdon, Tobias Lear, the private secretary of George Washington, Benjamin P. Shillaber, James T. Fields, Thomas Bailey Aldrich and Gen. Fitz John Porter.

PORTSMOUTH, Ohio, city and county-seat of Scioto County, at the confluence of the Scioto and Ohio rivers, at the southern terminus of the Ohio Canal, and on the Chesapeake and Ohio, the Baltimore and Ohio, the Norfolk and Western, the Chesapeake and Ohio Northern and the Ohio Valley Traction Line railroads, about 80 miles in a direct line south of Columbus and 107 miles east by south of Cincinnati. It has steamboat connection with all the Ohio River ports. It was settled in 1803 and in 1814 was incorporated. It is in an agricultural region, and in the vicinity are valuable deposits of fire-clay. It is the commercial centre of an extensive mining and manufacturing section. The chief manufactures of the city are steel mill products, foundry and machine-shop products, paving and building brick, fire-brick, cars, lumber products, stoves, ranges, beer, rectified spirits, paper boxes, wagons, carriages, furniture, veneer factory products and boots and shoes. The invested capital in manufacturing plants is $7,500,000; and the value of the products aggregates $10,000,000 yearly. The principal public buildings are the government building, county courthouse, municipal buildings, some of the business blocks, the church and educational buildings. It has a city hospital, homes for old ladies and orphanages. The educational institutions are the public and parish schools, several private schools, a public library and the Hamilton Peebles reading room. The principal parks are Athletic, Grandview, York, Millbrook and Tracy. In the vicinity are interesting remains of the Mound Builders.

The government is vested in a mayor, who holds office two years, and a council. The administrative officials who are chosen by popular vote are the members of the school board, the justices of the peace, the board of public service, the assessors, city treasurer, city solicitor and city auditor. The business management of the city is in charge of the board of public service. Other subordinate officials are appointed by the mayor, subject to approval by the council, or are elected by the council. The city owns and operates the electric-light plant and the waterworks. Pop. 30,000.

PORTSMOUTH, R. I., town and county-seat of Newport County, 10 miles north by east of Newport, on the New York, New Haven and Hartford Railroad. It has a public library, courthouse, good schools, churches, etc. Agriculture and fruit-growing are the chief industries. Pop. 2,861.

PORTSMOUTH, Va., city and county-seat of Norfolk County, occupies the western or mainland side of the harbor of Norfolk-Portsmouth, where the larger rail systems of the South — the Southern Railway, Atlantic Coast Line Railroad and Seaboard Air Line Railway — have their deep water terminals; other lines serving Portsmouth are the New York, Philadelphia and Norfolk (Pennsylvania System), Chesapeake and Ohio, Virginia, Norfolk and Western and Norfolk Southern. Norfolk which lies just across the harbor is connected by a commodious steam ferry which runs at 10 minute intervals, also by railroad ferries. The city is governed by a council of seven, one of whom is the chairman and in all respects is mayor, excepting he is without the power of veto. The council selects a manager and the people expect results. This new form of government took effect 1 Sept. 1916. Real estate and personal valuations total $15,297,507, which together with railroad property assessments and the government holdings bring the total to $32,297,507. Portsmouth was named for the city of that name in England. Its most notable feature is the navy yard; although situated within seven blocks of the heart of Portsmouth, it is officially known as the Norfolk navy yard. Built by the British in the 18th century, it was purchased by the United States in 1801. Burned by the Federals in 1861, it was rebuilt by the Confederates and held by them until Portsmouth was reoccupied by the Federals near the close of the war. It is now the most important and largest in the country, occupies 350 acres, has three large drydocks and another has been authorized by Congress. General travel is facilitated by the centring in this harbor of five other roads and numerous steamship and steamboat lines, while foreign transportation is represented by many of the great trans-Atlantic lines. It is estimated by the United States government that the value of the traffic passing through the harbor during the fiscal year 1915 approximated in value $1,373,142,923 and represented a tonnage of 36,433,935. Exports during the same period totaled $20,000,000 and imports nearly $4,000,000. Seventy-five manufacturing concerns representing 42 industries have sprung up within a comparatively short period, due to a manufacturing zone that followed the building of a belt line railroad to facilitate the interchange of freight between the eight rail lines. Cotton seed oil products, soap for textile purposes, talcum powder, creosoted conduits, underwear, hosiery, excelsior, butter dishes, copper smelting, cotton seed hull products, blotting paper, paper boxes, dyeing, box shooks, etc., are among the many items that are manufactured here. Portsmouth contains a naval training station, a naval magazine and a United States Naval Hospital and park; also the King's Daughters Hospital, armory, public library, orphanages, homes for the aged, a Y. M. C. A. building, Trinity Church, built in 1762 and several large commercial structures. Pop. 39,658.

PORTSMOUTH, Treaty of. The treaty of peace signed 5 Sept. 1905 at the navy yard, Portsmouth, N. H., which ended the Russo-Japanese War, 1904–05. After nearly 16 months of war between Russia and Japan over the former nation's occupation policy in Manchuria (q.v.), President Roosevelt in the early part of May 1905 made known his sincere belief that the time had come for the two belligerents to end the war and conclude peace. In accordance with these proposals Russia and Japan named their plenipotentiaries, who were sent to the Portsmouth, N. H., navy yard, which had been selected as the place of conference, and on 10 August the negotiations were begun. On 29 August an accord was brought about, the treaty signed by the plenipotentiaries on 5 September, and approved by the emperor of Japan and the tsar of Russia on 14 October to take effect on the 16th. Japan consented to yield some of the Manchurian territory won and Russia consented to Japanese supremacy in Korea. Incidentally, owing to racial sympathies and because of the prestige gained, Japan attained supremacy in Chinese affairs. See CHINA; JAPAN — *Russo-Japanese War;* RUSSIA — *History.*

PORTUGAL, pōr'tū-gal (Port. pōr-too-gäl'), the southwesternmost republic of Europe, on the Iberian or Pyrenean Peninsula, between Spain and the Atlantic Ocean. The Portuguese title is *Republica Portuguesa.* No natural boundaries separate Portugal from Spain, except on a small part of the frontier, the Minho River forming part of the northern boundary, and the Guadiana River part of the southeastern. The shape of Portugal is nearly that of a parallelogram. Its greatest length, north to south, is 353 miles, greatest breadth 138 miles, extending respectively between latitudes 36° 55′ to 42° 7′ N., longitudes 6° 15′ to 9° 30′ W. The territory is divided into the three provinces of Minho, 2,790 square miles; Tras-os-Montes, 4,163 square miles; Beira, 9,208 square miles; Estremadura, 6,937 square miles; Alemtejo, 9,219 square miles; Algarve (Faro), 1,937 square miles; and, with the insular provinces, comprising the Azores, 922 square miles, and Madeira, 314 square miles, gives a total area of 35,490 square miles for the republic; but this does not include the colonies noted below. The only large cities are Lisbon (q.v.), the capital, and Oporto (q.v.), the chief port. Setubal, Funchal (Madeira), Braza and Coimbra have each over 20,000 population.

Colonies.— Besides the Azores and Madeira islands, mentioned above, the Portuguese African colonies are 823,334 square miles in area, with an estimated population of over 8,000,000. The largest of these is Portuguese West Africa, formerly called Angola; nearly as large is Portuguese East Africa (q.v.), formerly called Mozambique. There are also the Cape Verde Islands (q.v.), Portuguese Guinea (q.v.), Principe (or Prince's) and Saint Thomas islands. Their Asiatic colonies of 8,933 square miles have an estimated population of 950,000. Goa, Damio and Timor in India, and Maceo Island and some small islands in the Indian Archipelago complete the other dependencies.

Topography and Physical Features.— The coast-line, of great length in proportion to the extent of the whole surface, lies mainly north and south on the Atlantic, but extends some 50 miles westward to Cabo da Roca, the most westerly point of the peninsula and of continental Europe. Here it becomes somewhat irregular, forms two bays — that of Lisbon and that of Setubal — by the interjection of the remarkable promontory which terminates in Cape Espichel, and again curves round in a south-southwesterly direction till it reaches Cape Saint Vincent, where it suddenly turns east. This direction it retains to its termination at the mouth of the Guadiana. It is occasionally bold and rises to a great height, particularly at Cabo da Roca, where it presents a range of precipitous cliffs; but for the greater part is low and marshy, and not unfrequently lined by sands and reefs, which make navigation dangerous. It is indented by some 21 harbors; the only ones of importance, either from their excellence or the trade carried on at them, are those of Lisbon, Oporto, Setubal, Faro, Figueira, Aveiro and Vianna. The interior is generally mountainous, a number of ranges stretching across the country, either in west, southwest or south-southwest directions, forming a succession of independent river basins, while their ramifications, penetrating in all directions, form the watersheds of numerous subsidiary streams and enclose many wild and beautiful valleys. The loftiest range is the Serra da Estrella, which may be considered as a continuation of the central chain which stretches across Spain between Old and New Castile, and between Leon and Estremadura. Near the town of Guarda it forms a sort of fork, one limb of which proceeds north and another southeast, while the main chain, running southwest, attains its culminating point of 6,537 feet about five miles west of the town of Covilhão, and ultimately terminates in the lofty cliffs of Cabo da Roca. Nearly parallel to this chain, and at no great distance from it, are on the north the Serra de Alcoba, and on the south the Serra Moradal. In the north branches or continuations of the Spanish mountains enter Portugal, and attain heights of 4,740 feet in Peneda, and of 5,180 in Larouco. At the opposite extremity the Serra Monhique, stretching across the country at a short distance behind the south shore, attains, at its western extremity in Mount Foia, the height of nearly 3,000 feet. The rugged nature of the surface makes the plains both few in number and of limited extent, but many valleys equally remarkable for beauty and fertility occur. The chief plains are those of Almedia and the Terra de Braganza, the former in the province of Beira and the latter in that of Tras-os-Montes; the chief valleys, those of Chaves, Villarica and Besteiros.

Hydrography.— No rivers of importance take their rise in Portugal, and yet few countries in proportion to their extent are better supplied with large and navigable streams. The Minho in the north, forming the boundary between Spain and Portugal in the lower part of its course; the Douro, first skirting the east frontier and then pursuing its course west to its mouth at Oporto; and the Tagus, all flow east to west; the Guadiana is the only large river of Portugal which deviates from the general westerly direction, and flows mainly south, forming part of the boundary line with Spain. In addition to these rivers, for which Portugal is indebted to Spain, the purely local rivers are the Vouga, Mondego and Sado. Numerous small lakes are scattered over the plains and among the mountains and valleys. The fisheries, especially those of sardine and tunny, are of considerable commercial importance, giving employment to about 45,000 people. The yearly catch is worth $5,000,000.

Geology and Mineral Resources.— The nucleus of the mountains is usually granite, overlain in the north by micaceous schist and other metamorphic rocks. Crystalline rocks and Palæozoic formations (especially Silurian) occupy about two-thirds of the surface, but the Jurassic, the Cretaceous and various Tertiary formations are also represented in the more southerly parts of the country. Volcanic formations are very apparent in the Serra de Caldeirão, forming a continuation of that of Monchique. The mineralogical treasures seem more remarkable for their variety than for their value, though some are, and many more it is supposed might be, worked to advantage. They include argentiferous lead, copper, iron, cobalt, bismuth, antimony, fine marble, slate, saltpeter, lithographic stones, mill-stones and porcelain earth. Some gold also is washed from the sands of the Douro, Mondego and other streams, and in several serras, particularly those of Estrella and Gerez-Larouco; and many valuable pebbles and rock-crystals are found in a great number of places. Large quantities of salt are formed in bays along the coast by natural evaporation; there are numerous salt marshes; and over 200 mineral springs, mostly impregnated with sulphur.

Climate.— The climate is greatly modified by the proximity of the sea and the height of the mountains, the former tempering the excessive heat of summer by refreshing breezes and the latter making the winter more rigorous than usual in countries under the same latitude. In general, however, winter is both short and mild, and in some places never completely interrupts the course of vegetation. In consequence of this many parts of Portugal enjoy the benefit of a double spring. Early in February vegetation is in full vigor; the plants shoot forth rapidly, attain maturity and either wither away or if of economical value are gathered and harvested. During the month of July the heat is often extreme, and, rain seldom falling, the whole country, particularly at its lower levels and along the coast, assumes a very parched appearance. The drought generally continues throughout August and far into September; but at last the sky, which had previously been serene, becomes overcast and copious showers descend. The second spring now begins, and the fields again become covered with flowers and verdure. Winter begins at the end of November. In the mountainous districts the loftier summits obtain a covering of snow and retain it for a greater or less period according to their altitude; but in all the country south of the Douro, and at a moderate elevation, snow generally soon melts away. The mean annual temperature in the north of Portugal is about 50° F., and of the south 65°. Deluges of rain, however, continue to fall, with occasional violent hurricanes and thunderstorms. Shocks of earthquake are sometimes felt, particularly in the vicinity of the metropolis, where those of 1755 were overwhelmingly disastrous.

Forestry, Flora and Fauna.— Many of the mountains are clothed with fine forests, chiefly pine and oak, both the ordinary species, or *Quercus robur,* and the cork-tree, or *Q. suber,* are conspicuous. In the central provinces, at a moderate elevation, magnificent chestnuts are very prevalent. Nearly one-sixth of the country's area is in timber, there being 2,000,000 acres of pines, over 1,000,000 acres of oaks, 800,000 acres of cork-trees and 210,000 of chestnut. In the south, in the province of Algarve, both the date and the American aloe are not uncommon. There are few countries with a more varied flora than Portugal. The number of species has been estimated to exceed 4,000, and of these more than 3,000 are phanerogamous. Both the flora and fauna of the kingdom are similar to those of Spain (q.v.).

Land Tenure, Agriculture and Stock-Raising.— The common forms of land tenure are peasant proprietorship, tenant farming, métayage and emphyteusis (ground rent). Large estates and tenant farming are common in the south; peasant proprietorship and emphyteusis prevail in the north. Agriculture is just about equal to the country's needs, one-fourth of the area being in cereals or grass and 7 per cent in vineyards and fruit orchards, 17 per cent under forest and 43 per cent is waste land. Barley and rye are important crops in the north, elsewhere wheat and maize are of more importance. In swampy localities some rice is grown. The production in 1916 was: wheat, 7,115,790 bushels; rye, 2,676,107 bushels; oats, 3,189,078 bushels; barley, 1,158,461 bushels; beans, 1,102,401 bushels; potates, 1,709,527 hundredweight. In the north the chief products are maize and oxen, in the central region, wheat and maize and in the south, wheat and swine. Wine is produced in large quantities. In 1917 the vintage amounted to 109,808,265 gallons. Olive oil was produced the same year to the extent of 362,094,084 gallons. Figs and tomatoes are also important crops.

Fruits of excellent quality are common in every quarter, though it is only in the warmer and better-sheltered districts that the orange, lemon and olive are cultivated with success on an extensive scale. The mulberry is admirably adapted to the climate, and by means of it a good deal of excellent silk is obtained; and a large extent of country is devoted to vine culture, caused partly by the demand for Portuguese wines in Britain. Among domestic animals the first place is due to the mule, of which very superior breeds have long been possessed and are carefully preserved. Sheep, goats and hogs are numerous, but little attention is paid to their improvement. Cattle are of comparatively less importance.

Manufactures and Commerce.— Manufactures are still limited, although they have been rapidly increasing of late years, and cotton goods are now exported. Among the articles made to some extent on a wholesale or commercial footing are textiles at Lisbon; woolen cloth and other woolen stuffs at Portalegre, Covilhão, etc.; porcelain at Vista Alegre; delft and ordinary earthenware at Lisbon, Oporto, Coimbra, Beja, Estremoz, etc.; cottons at Oporto; prints and lace at Lisbon and Oporto; cotton-twist at Thomar; silks at Braganza, Chacim, Oporto, etc.; copper and tinware at Lisbon and other places; corks, ribbons, embroidery, hats, confectionery, fine soap, jewelry and cut gems, glass, paper, wickerwork and tobacco. Shipbuilding is carried on to some extent, vessels being constructed at Lisbon, Figueira, Oporto and elsewhere. The principal exports besides wine are cork, cattle, cottons, olive-oil, sardines and tunny fish, fruits, iron and copper pyrites, tin and horses; the principal imports are cereals, colonial produce, woolen, cotton, linen and silk tissues, iron, steel and various other metals, machinery, cured fish, coal, petroleum, timber, dyes and drugs, etc. In 1913 (the last normal year before the war) the value of the exports was over $40,000,000 (more than half foods), imports $78,000,000. The bulk of the trade is with Great Britain and France, and the chief export to the former is wine. The value of the wine sent to Great Britain annually is nearly $5,000,000. Coal and cotton goods have the highest value among the exports from Great Britain to Portugal, with considerable amount in iron (wrought and unwrought) and machinery.

Shipping and Navigation.— The mercantile shipping of the republic in 1911 comprised 66 steamers and 259 sailing vessels, with an aggregate of 114,000 tons. In 1914, 9,017 vessels of 20,505,334 tons entered, and about the same total cleared the ports of Portugal.

Communications.— The length of sea-coast, with the harbors found upon it, and the number of rivers, furnish great facilities for trade, but all the other means of internal communication are defective. There are over 9,000 miles of public roads; in 1914, 1,849 miles of railway were open for traffic, of which 711 miles were owned by the state; in the same year there were over 5,945 miles of telegraphic line in operation. There are 4,300 post offices, handling annually 55,000,000 letters, 24,000,000 cards, and 50,000,000 pieces of printed matter.

Money, Weights and Measures.— The republic of Portugal established a new monetary system, the main unit being the escudo, worth a little more than one dollar, or 100 centavos; four and one-half escudos are legal tender for an English sovereign. Paper and silver are the chief media of circulation. The French metric system of weights and measures was introduced into Portugal between 1860 and 1863. The Portuguese *libra* was 1.012 pound avoirdupois, the *arroba* was 32 libras, the *quintal* four arrobas. The chief linear measures were the *legoa,* or league of 18 to the degree; the *milha,* or common geographical mile; the *braça,* or fathom=7.4 feet; the *vara,* or yard, one-half of the former; and *pe,* or foot=about 13 inches. For dry measure the *moyo*=22 bushels; and for liquids the *almudo*=from 3.7 to 5.6 gallons, were used.

Government.— The last king of Portugal was Manoel II, who came to the throne 1 Feb. 1908, on the assassination of his father and elder brother, Luiz Philip. In 1910 there was a short revolution, that culminated 5 October in the proclaiming of La Republica Portuguesa. A provisional government held authority until a constitution had been formed and a regular election took place, in August 1911, when Manoel de Arriaga was chosen the first constitutional President (24 Aug. 1911–27 May 1915). He did not serve out his term, but was succeeded by Theophilo Braga as provisional President from 29 May to 5 Oct. 1915. The new constitution was patterned in some respects after that of the United States, though with several marked differences. There are two Chambers, the National Council, having 164 members, directly elected every three years, and the Second or Upper Chamber, of 71 members, elected by all the municipal councils, half of them elected every three years. The Chambers elect the President for a single term of four years. The President appoints the Cabinet or Ministry, but they are responsible to the Parliament, consisting of the two Chambers. The constitution may be revised once in 10 years. Bernardino Machado was elected the second constitutional President of the republic, and took office 5 Oct. 1915. On 25 April 1917, he formed a new Cabinet, Affonso Costa being Premier and Minister of Finance, Lieut.-Col. Norton de Mattos, Minister of War, and Augusto Soares, Minister of Foreign Affairs. Machado held office until 8 Dec. 1917, when he was swept out of office by a revolution. A revolutionary Junta succeeded; it was led by Sidonio Paes, who, on 12 Dec. 1917, became Premier and on the 28th of the same month was made acting President, pending the regular election of a President by Congress. On 28 April 1918 Paes was elected President. The new government assumed the old public debt, which was about $800,000,000, and which has grown steadily, being at the billion mark in 1918. The revenue for the three years previous to the war was about $84,000,000 annually, with slightly greater expenditures. In 1917 the revenue fell off and the expenses were scaled to meet the funds. The war expenses were separate. (See ARMY AND NAVY). In addition the colonies of Portugal have an annual revenue of about $18,000,000, balanced by equal expenditures.

Banking.—The Government financial institution is the Bank of Portugal, which has branches in 22 cities. Taking the last normal year (1914) as the fairest statement the annual transactions are about 1,205,000,000 escudos ($1,301,000,000), and the cash on hand—gold 8,505,000; silver, 3,563,000; nickel, 104,000; copper, 13,517 escudos. Bills discounted, 66,000,000; loans, 2,327,000 escudos. There are 18 other banks, with 47,000,000 escudos capital, and deposits of 30,000,000 escudos.

Army and Navy.—The army consists of about 30,000 men on the peace footing and 175,000 on a war footing. Compulsory service was introduced in 1895, and all above 21, with certain exceptions, are liable to serve three years with the flag, five in the first reserve, and seven in the second. The reserve army, which was mustered during the World War, consisted of 35 regiments of infantry, eight squadrons of cavalry and 24 field batteries. The military bugdet for 1915–16 was over $100,000,000, to which was added $42,000,000 for extraordinary expenses. The navy consists of five protected cruisers, some old gunboats, five destroyers, four torpedo boats, three submarines, etc., with a program for constructing three more cruisers, three dreadnoughts, 12 destroyers and six submarines.

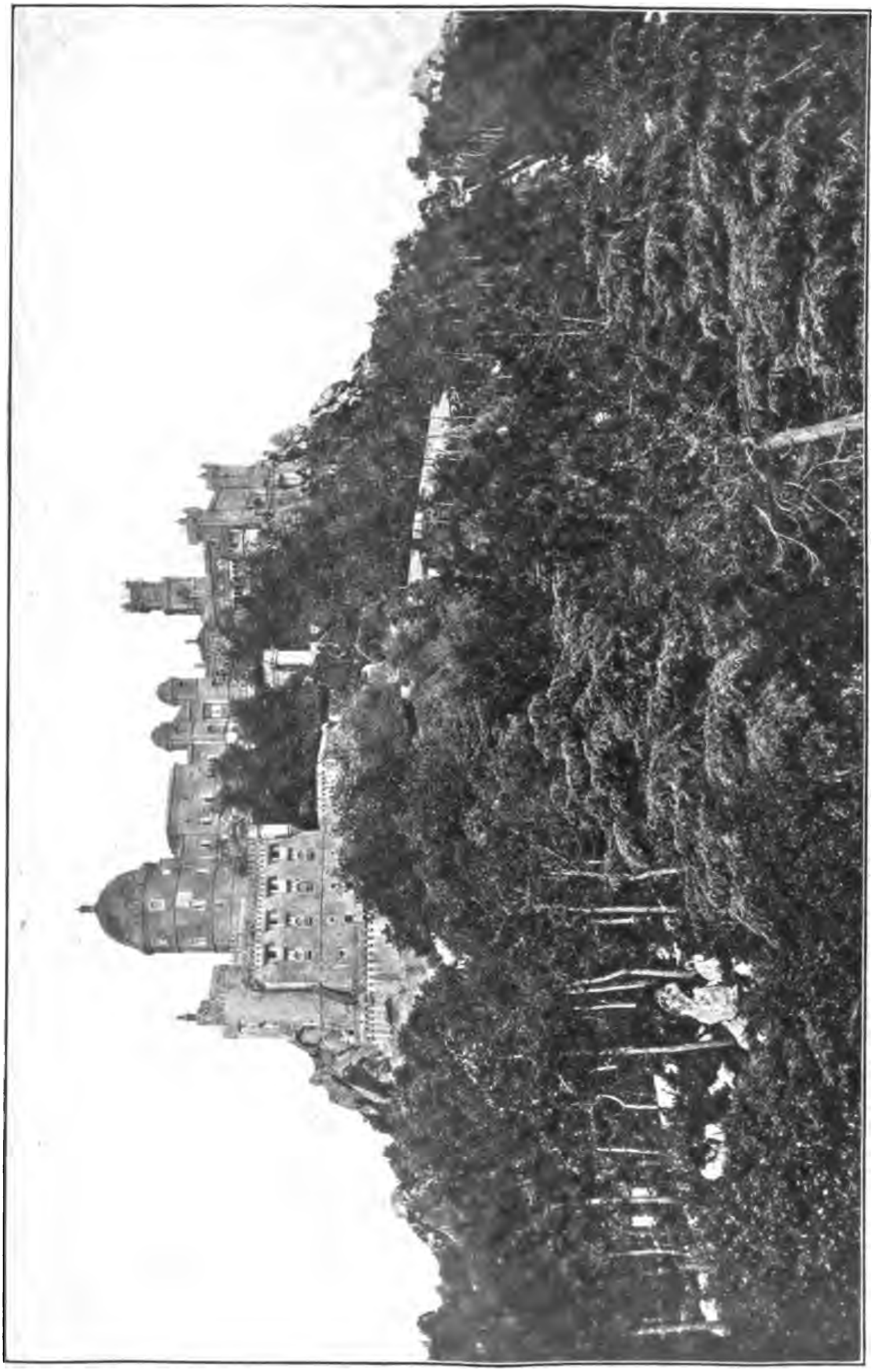
Ethnology.—The Portuguese are a mixed race—originally Iberian or Basque, with later Celtic admixture. Galician blood (derived from the ancient Gallaici, presumably Gallic invaders) predominates in the north; Jewish and Arabic blood are strongly present in the centre, and African in the south. The Portuguese differ essentially from their Spanish brethren, whom they regard with inveterate hatred and jealousy, mainly on account of their past attempts to subvert the independence of Portugal. They are short of stature, have a long cranial index, dark hair and olive skin. The opinions of observers differ as to the national traits of the people. They are, however, generally sober, good-natured, obliging and patriotic, but shiftless and not over-clean.

Population.—At the last census there were 2,828,691 males and 3,131,365 females. The urban population was 32.4 per cent and the rural 67.6 per cent of the total. The foreign population in 1911 numbered 41,197, comprising 20,517 Spaniards, 12,143 Brazilians, 2,576 English, 1,832 French and 1,645 Armenians. The rate of illegitimate births is 12.5 per cent of the total births. In 1914 there were 193,942 births, 117,967 deaths and 41,724 marriages. In the same year 25,722 persons emigrated chiefly to Brazil and the United States.

The following table gives the population at the census of 1900 and 1911. The Azores and Madeira are regarded as an integral part of the republic:

PROVINCES AND DISTRICTS	Area, sq. miles	Population	
		1900	1911
Entre Minho-e-Douro			
Vianna do Castello	857	215,267	227,420
Braga	1,040	357,159	382,461
Porto	893	597,935	679,978
	2,790	1,170,361	1,289,859
Tras-os-Montes			
Villa Real	1,650	242,196	245,687
Bragança	2,515	185,162	192,133
	4,163	627,358	437,571
Beira			
Aveiro	1,065	303,169	336,243
Vizeu	1,937	402,259	416,860
Coimbra	1,508	332,168	360,056
Guarda	2,116	261,630	271,816
Castello Branco	2,582	216,608	241,509
	9,208	1,515,834	1,626,484
Estremadura			
Leiria	1,317	238,755	262,558
Santarem	2,555	283,154	322,753
Lisbon	3,065	709,509	853,415
	6,937	1,231,418	1,438,726
Alemtejo			
Portalegre	2,405	124,431	141,778
Evora	2,856	128,062	144,307
Beja	3,958	163,612	192,499
	9,219	416,105	478,584
Algarve (Faro)	1,937	255,191	274,122
Total Continent	34,254	5,016,267	5,545,595
Islands:			
Azores	922	256,291	242,613
Madeira (Funchal)	314	150,574	169,777
Total Islands	1,236	406,865	412,390
Grand total	35,490	5,423,132	5,957,985

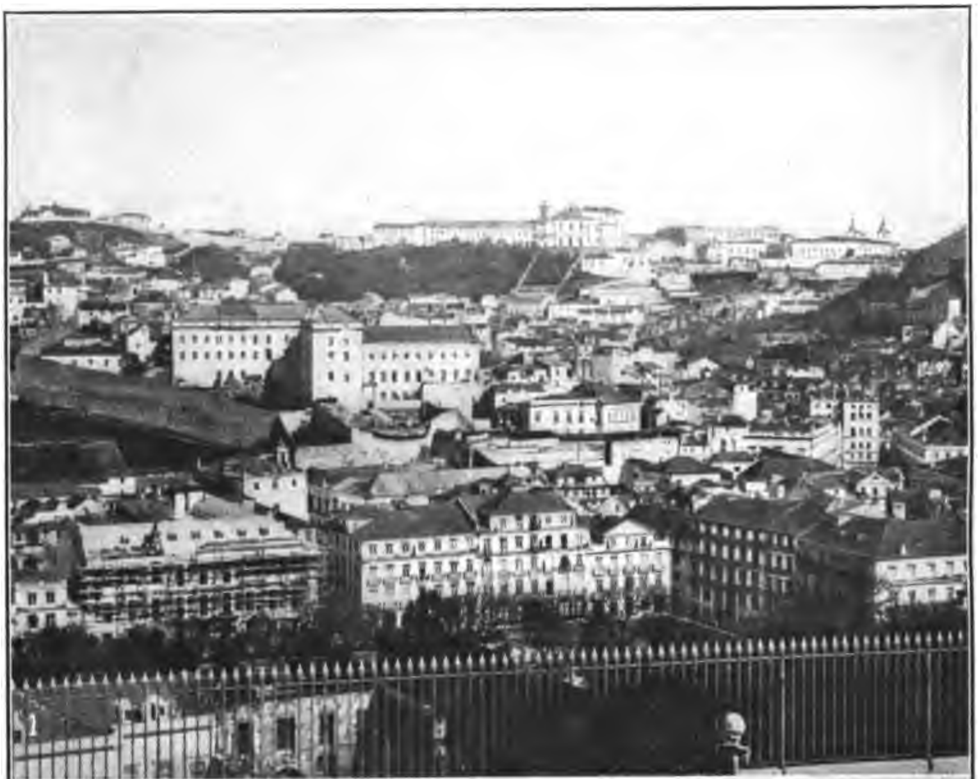
Religion, Education.—The state religion was that of the Catholic Church, which largely prevails, though toleration is extended to all other creeds. There are three ecclesiastical provinces presided over by the cardinal patriarch of Lisbon, the archbishop of Braga, who is primate of the kingdom, and the archbishop of Evora; these dignitaries rule over 14 bishops. The monasteries were dissolved in 1834, their properties, yielding about 1,000,000 sterling annually, being appropriated by the state. Their books were collected, and form a library of 30,000 volumes at Lisbon. There are only about 5,000 Protestants, mostly foreigners, and 500 Jews. Education is superintended by a council, at the head of which is the Minister of the Interior, and is entirely free from the supervision and control of the Church. Compulsory education was enacted in 1844, but was far from being fully enforced, until the republic took it up actively in 1911. In 1913 there were 5,563 public elementary schools and 31 secondary schools, the teachers being trained in the universities (three in number), of Lisbon, Coimbra



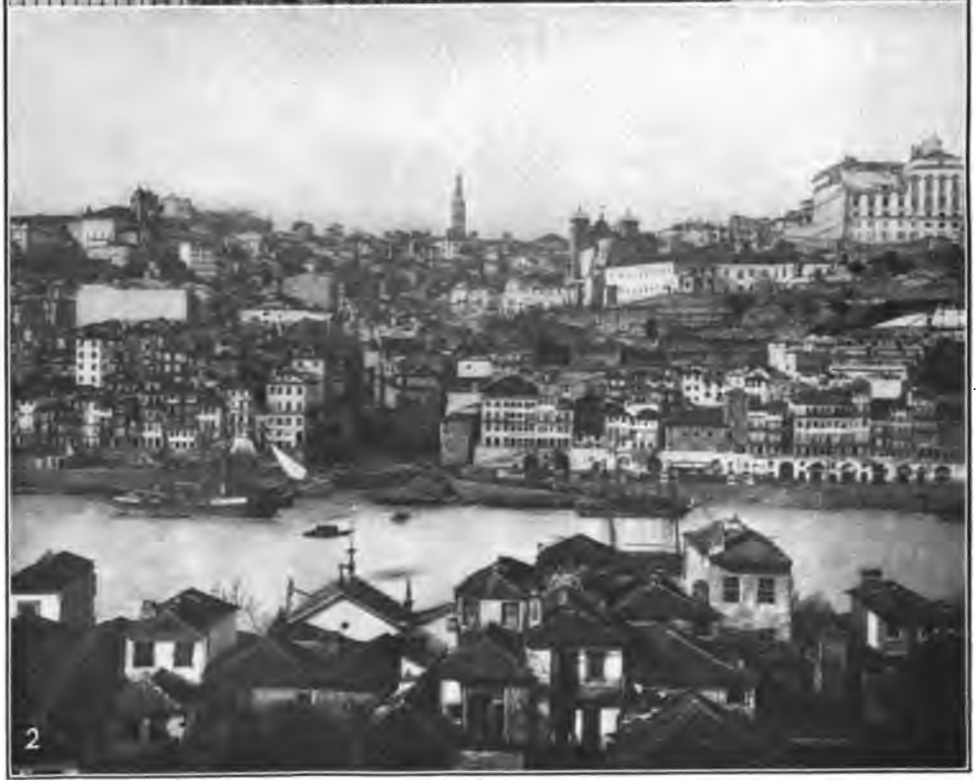
THE PICTURESQUE CASTELLO DE PENA AT CINTRA

Which, prior to the 1910 revolution in Portugal, formed King Manuel's summer residence

PORTUGAL



1 Lisbon



2 Oporto

and Oporto. The secondary schools had 11,000 students in 1916 and the universities over 3,000. There are also numerous private schools; polytechnic academies at Lisbon and Oporto; and clerical, medical, agricultural, naval and military training-schools. The university at Coimbra (established 1290), one of the oldest in Europe, has five faculties, 75 professors and about 900 students.

Judiciary and Local Government.— For judicial purposes Portugal is divided into 193 comarcas, each having a court of first instance. There are appeal courts at Lisbon, Oporto and Punta Delgada (in the Azores); and a Supreme Court at Lisbon. For the purposes of local government the six provinces of continental Portugal are subdivided into 17 districts, and the insular province into four, the Azores three, and Madeira one.

History.— Portugal forms the greater part of ancient Lusitania. It was subjugated by the Romans, in the time of Augustus, and was constituted into a province. In the 5th century, on the overthrow of the Roman supremacy, Portugal was invaded by the Alans and Visigoths, and suffered with Spain, of which it was then a part, all the troubles and vicissitudes endured by the inhabitants of the peninsula till the 8th century, at which time the Arabs, called indifferently Saracens or Moors, possessed themselves of the whole of Portugal, and kept absolute dominion for nearly 400 years. When the gallant Spaniards of the Christian kingdoms of Castile and Leon finally wrested the country between the Minho and the Douro from Moorish hands, they placed counts or governors over this region. Henry the Younger of Burgundy, whose grandfather Robert I, Duke of Burgundy, was grandson of the French king Hugh Capet, came into Spain about 1090, to seek his fortune in the wars against the Moors. Alfonso VI, king of Castile and Leon, gave him the hand of his daughter, and appointed him (1095) count and governor of the conquered districts, which comprised the provinces Entre Minho e Douro, Tras os Montes, and a part of Beira, and the harbors of Oporto (Portus Calle), from which Portugal is said to have derived its name. The count resided at Guimaraens, owed feudal service to the Castilian kings, but was permitted to hold in his own right whatever conquests he should make from the Moors beyond the Tagus (1112). Under his widow, Theresa (1114–28) the country acquired a sense of national unity and a certain measure of independence. Their son, Alfonso I, made Portugal an independent kingdom (1143) — through the victory of a picked body of Portuguese knights over a picked body of Castilian knights in a tournament — and gained signal advantages over the Arabs, whom he fought for 25 years, his greatest exploits being the victory in the plain of Ourique, in Alemtejo, in 1139, when he was saluted king of Portugal on the battle-field, the capture (with the help of English crusaders) of Lisbon in 1147, and of Alcacer do Sal in 1158. The Burgundian House, which continued in possession of the throne for 440 years, gave to Portugal some of its best kings. The immediate successors of Alfonso I were engaged in incessant wars against the Moslems and in severe struggles with the clergy and nobles, who were always ready to combine against the sovereign; but, although often baffled in their attempts to uphold the independence of the crown, the dignity of the kingdom was, on the whole, well maintained by the representatives of this family, who were, moreover, distinguished as the promoters and champions of the maritime glory of Portugal. Prominent among these was Diniz or Denis (1279–1325), son of Alfonso III. He encouraged agriculture, manufactures, navigation and commerce. He admitted the representatives of towns to the Cortes. He liberally patronized learning, and founded a university at Lisbon, which in 1308 he transferred to Coimbra. By these and other acts of a wise and beneficent administration he earned the title of «Father of his Country.» Among his other cognomens the most frequently applied is the «Farmer.» He was succeeded by Alfonso IV. In conjunction with Alfonso II of Castile he defeated the Moors at Salado in 1340. He murdered Inez de Castro, the wife of his son Pedro, in 1355. (See CASTRO, INEZ DE). He was succeeded by his son Pedro I, who exhumed the body of Inez, and caused her to be crowned along with him (1361). He died in 1367, and was succeeded by Ferdinand, on whose death in 1383 the male line of the Burgundian princes became extinct. In 1385 the king of Castile laid claim to the crown, but was opposed by Don John, the illegitimate brother of Ferdinand, who ascended the vacant throne and ruled his subjects with justice and prudence. Under this wise and enlightened sovereign the Portuguese first directed their attention to those maritime adventures which subsequently placed Portugal at the head of all European nations. Under John I the Portuguese first projected those Atlantic discoveries on the African Coast, fraught with such territorial and commercial advantages to the nation; and, under John II and Emanuel, between 1481 and 1521, Vasco da Gama explored the Indian Ocean; the riches of the East began to pour into Europe; Goa became a prosperous possession, and Brazil was added to the possessions of the crown of Portugal. The latter monarch, Emanuel, has been regarded as the greatest and best man who ever sat on a throne. Under his wise, just and benevolent reign distress was banished from the kingdom, and his subjects rendered rich and happy. Sebastian III, fired with a holy zeal to exterminate the infields from his country, commenced a sanguinary crusade against the Moors, which he carried on through such repeated defeats that he eventually lost both his crown and life in the struggle. With Henry the Cardinal, his uncle, an old man of 70 who died after a reign of two years, the male line terminated, after enduring for 460 years. Spain once more laid claim to the vacant throne, and Portugal again became a dependency of the Spanish crown, the nation suffering all the injustice, exactions and tyranny usually inflicted on a conquered country by its haughty masters. After enduring 60 years of intolerable hardships and exactions, a Portuguese nobleman named John, Duke of Braganza, pitying his unfortunate countrymen, excited a revolution, which again broke the Spanish fetters, while the people hailed their deliverer as their king, who, being crowned as John IV, commenced the dynasty of the House of Braganza, a family whose descendants still sway the destinies of Portugal. During the 18th century, as an ally of Great Britain, Portugal became rather a commercial dependent, especially after the Methuen Treaty (q.v.) of 1703.

When Napoleon, in 1807, entered the country, and declared the family of Braganza had ceased to reign, the royal family of Portugal, consisting of Pedro, the old king and his imbecile wife, Maria Frances Isabella, queen-regent, the prince-regent and all the court set sail from the Tagus to Brazil, transferring the capital to Rio de Janeiro. On the death of the queen-regent, John VI ascended the throne of Portugal and Brazil. After the downfall of Napoleon, the history of Portugal is composed of a long succession of political disturbances. The Inquisition introduced in 1536 was abolished in the Portuguese dominions in 1815, and the Jesuits, established in 1540 and banished in 1759, were refused admission. The Jews, at the request of the pope in 1817, were allowed the same privileges which they enjoyed in the Roman states. The absence of the court was viewed with dislike by the nation; the military were dissatisfied with the British influence of Marshal Beresford and the general feeling required some fundamental changes in the administration and constitution of government. A revolution in favor of constitutional government was effected without bloodshed (1820), and the king invited to return home. Before landing in Portugal he swore to observe the constitution which had been adopted. A counter-revolution of the nobles and clergy was vigorously repressed by the Cortes (February 1823); but the queen, a Spanish infanta, who exercised great influence over her son, Dom Miguel, gained the colonels of several regiments; a new reactionary movement was organized; and the Cortes, being overpowered, dissolved itself after a solemn protest on 2 June 1823. In 1822 Brazil threw off the yoke of Portugal, and proclaimed Dom Pedro, son of John VI, emperor. Her independence was recognized in 1825. John VI died 10 March 1826, having named the Infanta Isabella Maria regent. She governed in the name of the Emperor of Brazil, Dom Pedro IV of Portugal, who granted a constitution with two chambers, modeled on the French, 23 April 1826. In May he abdicated in favor of his daughter Maria da Gloria. He imposed on her the condition of marrying her uncle Dom Miguel, who was entrusted with the government as regent; but the Absolutist party in Portugal set up the claim of Dom Miguel to an unlimited sovereignty and a revolution in his favor, notwithstanding the intervention of England placed him on the throne in 1828. In 1831 Dom Pedro resigned the Brazilian crown and returning to Europe, with the aid of English partisans succeeded in overthrowing Dom Miguel and restoring the crown to Maria in 1833. In 1836 a successful revolution took place in favor of the restoration of the constitution of 1820 and in 1842 another in favor of that of 1842. Maria died in 1853. Her husband, Ferdinand of Saxe-Coburg, brother of Prince Albert of Britain, became regent for her son Pedro V. He placed the government on a purely constitutional basis, which was maintained by his son Pedro, who died in 1861 and by Louis I, who succeeded him and who died in 1889. The abolition of monopolies, the improvement of finances, the formation of railways and the cadastral survey of the country, are among the measures which distinguished his reign. Slavery was abolished in 1868 in the Portuguese dependencies. Carlos I ascended the throne in 1889. His reign was marked by serious colonial, financial, social and political troubles. Carlos and his oldest son were assassinated and his second son driven from the throne. A national assembly was formed and on 19 Aug. 1911 it completed and signed the constitution of the Republic of Portugal and elected a President as stated under *Government*. Portugal came into the World War on the side of the Entente Allies in 1916.

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PORTUGAL, Orders and Decorations. See Orders (Royal) and Decorations of Honor.

PORTUGUESE AND BRAZILIAN LITERATURE. See Portuguese Language, Literature, and Art.

PORTUGUESE (pōr′tū-gēs, or -gēz) **EAST AFRICA,** or **MOZAMBIQUE.** See East Africa; Portuguese; and Mozambique.

PORTUGUESE EAST INDIA COMPANY. See East India Companies.

PORTUGUESE GUINEA, a northwest African colony on the Atlantic Coast, extending from the Cacheco River southward to Katafine, and eastward to long. 13° W., its boundaries on all its land sides, fixed by the convention of 12 May 1886, being the French Senegambian possessions. The climate is very hot and unhealthful for Europeans. The Bissagos archipelago with other islands off the coast belong to the colony, which has a total area of 14,440 square miles. The capital and chief port is Bulama on Bulama Island; other trading ports are Bissao, Bubah, Geba and Cacheo. The coast is indented by the estuary of the Rio Grande River with its numerous deltaic islands; the colony from the eastern mountains westward lies on both sides of the river and is mainly an alluvial plain covered with tropical forests and vegetation. Rice and millet are cultivated. The chief commercial products, largely controlled by the French, are rubber, ivory, hides, oil-seed and wax; the annual exports amount to over $6,000,000; the imports to $1,500,000. There is a small coasting trade, 150 vessels with an aggregate of 57,007 tons, entering the ports in one year. There is fine hunting, elephants and hippopotami being still common. The colony is administered by a Portuguese governor and council. The military force numbers about 250. The colony is non-supporting, the revenue being less than the expenditure. The United States in 1870 as umpire settled the long-standing disputes between Great Britain and Portugal over this territory in favor of the latter. The population, almost wholly native blacks, is estimated at about 1,000,000. Consult Machat, J., ‘Rivieres du Sud’ (Paris 1906).

PORTUGUESE LANGUAGE, LITERATURE AND ART.— The Portuguese is one of the Romance family of languages, formed by the junction of the Latin-speaking Celts with the Teutonic races. Words of Greek, Phœnician, Iberian, Celtic and Carthaginian origin are found in Portuguese as in Spanish, indicating the relations into which commerce or conquest had brought the early inhabitants of the country. The Moorish occupation has further infused into it a Semitic element. Under the early kings of Portugal all documents were written in Latin; judicial sentences were written in Latin till a comparatively recent time; it is still used in seals, coins and monumental inscriptions. It was only under Alfonso III and Diniz that Portuguese began to be generally used in documents. The differences between Portuguese and Spanish are comparatively of modern origin, the two languages being very nearly alike in the time of Alfonso I (1143). These differences are due partly to the different spheres of activity of the two peoples. The relations of Spain were with France, Italy, Austria, and the Low Countries; those of the Portuguese were almost exclusively with the Spaniards themselves, or with peoples removed from European civilization. The dialect of Spanish spoken in Portugal at the beginning of the monarchy, moreover, was the Galician, which was also that of the court of Leon; but that court subsequently adopted the Castilian, which became the dominant language of Spain. The decline of the Galician dialect in Spain and the formation of the Portuguese language through the influences peculiar to the people finally determined the separation of Spanish and Portuguese, and from cognate dialects made them distinct languages. Early French introduced by Henry of Burgundy and his suite also constituted an element in the formation of the Portuguese language, and old French words which have fallen into desuetude are still to be found in Portuguese. The heraldic devices of the oldest Portuguese families are in French, while in modern times the Portuguese have shown a strong tendency to imitate the French in everything, and the language has been considerably modified by the introduction of French expressions and grammatical forms.

The 16th century is the classical age of Portuguese literature, and the Royal Academy of Sciences began a dictionary in which all doubtful points in regard to the language are referred to quotations from the writers of that age. There is no determined orthography except that which the rules of printers have made prevalent in printed books. Royal edicts and other public documents were formerly cited as models of language, but in later times they were far from being distinguished by accuracy.

The Portuguese language, by means of colonization and emigration, has been pretty widely spread. It is spoken in Portugal, the Azores, Brazil, the Portuguese colonies in Asia, Africa, and in the United States, and among the Portuguese Jews scattered over Europe, particularly in Hamburg and Amsterdam. The Portuguese possesses the richness and conciseness of the dialects founded on the Latin tongue. It appears to have derived from French the *j* sound and the nasal syllables, and it lacks the strong aspirations and guttural sounds of the Spanish. It has less dignity than the Spanish, but is superior in flexibility. In popular songs it displays a delicacy and variety of expression which have made the Spaniards call it the language of flowers. It makes free use of augmentives and diminutives. It is soft and sonorous in sound, but the too frequent occurrence of the nasal *ão* somewhat mars its harmony. The words are systematically grouped, every noun having in general an adjective, a verb and an adverb corresponding to it. Latin terms are preserved in Portuguese which are found in no other language in Europe; but these, as well as its other Latin elements, are more radically changed than elsewhere, so that it is often extremely difficult to trace the derivation of Portuguese words. Medial consonants, such as *l* and *n*, are frequently suppressed, *doler* becomes *dor; populus, povo; ponere, pôr* (Italian *porre*). The dialects of Portuguese differ only slightly from each other. Those of Minho, Algarve, the Azores in Europe, and of Goa, Macao, East Africa and Brazil are farthest from the written. The *lingoa geral* spoken on the eastern and western coasts of Africa, as well as in some parts of India and Ceylon, which bears an analogy to the *lingua franca* of the Mediterranean, may be regarded as a dialect founded on Portuguese, and as containing reminiscences of the ancient maritime power of the people.

Literature.— The earliest productions of Portuguese literature do not go back farther than 1125, from which date the poetical compositions of Egaz Moniz Coelho and of Gonzales Hermiguez. These are written in the Galician dialect. This closely resembled the Provençal and the Provençal bards who were received at the court of the kings of Portugal just missed assimilating the Portuguese as well as other languages of southern Europe to their own. The Provençal literature for some time absorbed all the efforts directed toward the cultivation of the higher arts of writing, and in Portugal, as elsewhere, it retarded the development of the native literature. During the 12th and 13th centuries the Portuguese native literature could boast of nothing more than a collection of popular songs (*chacras*), remarkable for freshness and vigor. The first Portuguese collection of poetry (*cancioneiro*) was made by King Diniz. It consisted of a selection of the court lays composed about this time by the Portuguese, Provençal and Galician bards. The manuscript of this collection, discovered in the Vatican by Ferdinand Wolf, has been published in Paris and Lisbon (1847) under the title of 'Cancioneiro del Rey Dom Diniz.' To Dom Pedro, Count of Barcellos, son of Diniz, is attributed a 'Cancioneiro do Real Collegio dos Nobres.' His half-brothers, Alfonso IV and Affonso Sanchez, were likewise poets. Some of the Portuguese poets of this time wrote in Castilian, and are reckoned among Spanish writers. Some poems on the death of his wife, one of which is in Castilian, are attributed to Pedro I, husband of Inez de Castro. There is also a prose chronicle of Pedro's reign by Fernão Lopez, from which are derived the chief particulars of his vengeance on the abettors of the murder. In the 15th century the court was still the centre and source of the national literature. The sons and grandsons of John I were poets and patrons of the troubadours. Galician, Castilian and Provençal were still cultivated as well as the native language. Garcia de Resende, a poet of some merit, who lived under Emanuel, has collected in a Cancioneiro (Lisbon 1516) the principal poetical works of this age. Bernardim Ribeiro wrote pastoral poems and romances in imitation of the Italians and Spanish. Sà da Miranda, who succeeded him in the same line, marks the transition from the 15th to the 16th century and the separation of the Portuguese from the other Spanish dialects and from the language of the troubadours. This progress is also observable in the prose chronicles which record the current history of the day. The reign of King John, the discovery and conquest of Guinea, the career of Prince Henry and the first voyage of Columbus are among the subjects dealt with by the chroniclers. Literature still continued to be patronized by the royal family. King Edward (Duarte) wrote a book of morals for the use of his sons, and two works, 'The Art of the Cavalier' and 'The Loyal Councillor,' which have been republished in France. There is also a treatise on military art by Alfonso V. The 16th century is the classic era of Portuguese literature. Pastoral poetry, the epic and the chivalric romance flourished in an especial manner. The chief names are Sà da Miranda, Antonio Fereira, Camoens, Diego, Bernardes, Andrade, Caminha and Alvares do Oriente. Their compositions are distinguished by elegance and variety, but like other modern pastorals, exhibit rather a tedious affectation of rusticity than a life-like representation of rural life. Sà da Miranda has also written epistles, sonnets, hymns and other compositions. In his hymns he has employed for the first time the hendecasyllabic verse, which has become the chief instrument of Portuguese poetry. The numerous hymns, odes, elegies and sonnets of Camoens are equally distinguished for elegance, but are marred by numerous conceits according to the taste of the period. The principal epic and the greatest poem in the Portuguese literature, almost the only one which has acquired a European reputation, is 'Os Lusiadas' ('The Portuguese') of Camoens, which has placed its writer in the rank of the few great poets of the highest class whose genius is universally recognized by the whole world. (See CAMOENS). After Camoens as an epic writer comes Cortereal, who has celebrated the siege of Diú and the shipwreck of Sepulveda.

The Portuguese romance writers claim to be the originators of the character of Amadis, but the question remains undecided between them and the Spaniards. Vasco de Lobeiro, Francisco Moraes and Bernardim Ribeiro are among the leading romance writers. Lopez de Castanheda has written a Libro de Caballeria. The drama also began to be cultivated in the 16th century. The first *autos* and rustic dialogues were probably composed for the festivities of Christmas; a few rude comedies also preceded the classic period. Sà da Miranda studied and imitated Plautus. Ferreira, who followed his example, composed the first regular tragedy, Ines de Castro, only a few years after Sofonisba was produced at Rome by Trissino. Camoens wrote several theatrical pieces, among which are 'Amphitryon' and 'Seleucus.' *Autos, farsas* and *comedias magicas* were far more numerous than simple dramas.

The chronicles in the same age expanded into history. The events of their own day, in which their country played so large a part, afforded ample matter of inspiration for historians as well as poets. Barros is esteemed the Livy of Portugal though he is also a writer of fiction. He wrote the 'History of the Conquest of India' in an elegant, pure and energetic style. The 'Commentaries of Alphonso d'Albuquerque,' by a nephew of the conqueror; the 'Chronicle of King Manual and of Prince John,' by Damian de Goes, a Portuguese ambassador; the 'History of the Discovery and Conquest of the Indies,' by Lopès de Castanheda; the 'Chronicle of King Sebastian,' by Diego Bernardo Cruz, are all works of great merit. Narrations of voyages are fewer than might have been expected, but there are a few of great interest — 'A Letter to the King of Portugal on the Discovery of Brazil,' by Vas de Caminha, companion of Cabral; the 'Voyages of Magellan,' narrated by some of his comrades; and the 'Voyages of Pinto,' who visited China, Tartary, Arabia and other countries. This work is one of the classics of the 16th century.

The opening of the 17th century is distinguished by the crowd of imitative epics which naturally followed the success of the Lusiad. Quevedo de Castro, Mascurenhas and Brandam are among the principal authors of these works, the most noticeable feature of which is the national patriotism they continue to display after the loss of the political independence of Portugal. This century is also distinguished by great historical compilations. It was the period of repose after an epoch of great activity and the absorption of the Portuguese nationality in the more powerful monarchy of Spain naturally turned all eyes to the recent period of its glory. The 'Monarchia Lusitana' (1597–1690); Bernardo Brito's 'Eulogy of the Kings of Portugal'; Faria de Souza's 'Europa Portugueza' (1667); 'Asia Portugueza' (1666–75), 'Africa Portugueza' (1680); 'America Portugueza' (left in manuscript), the historical works of Numez de Laio, Manoel de Mello and others belong to this epoch. Antonio Vieira, a Jesuit preacher, is one of the most vigorous prose writers of this century. The letters of Alcofarrara are also among its notable productions. But the most prolific writer of all was the padre Macedo, who composed a number of epic poems, besides 110 odes and numerous dissertations. He wrote chiefly in Latin, Spanish and Italian.

The Portuguese drama was nearly extinguished during this century by the predominance of the Spanish, to which even Portuguese writers contributed. Cocho Rebello has collected a number of the minor indigenous productions of the art, 'A Musa Entretenida de Varios Entremeses' (Coimbra 1658).

In the 18th century the influence of the French writers of the age of Louis XIV so completely dominated Portuguese literature that it became almost entirely imitative. Translations from and imitations of the French formed the staple of its products in every department, and the nation that gave birth to the Lusiad condescended to copy the Henriade and the Lutrin. Scholarship in this age made greater progress than literature. The academy called the Arcadia was founded in 1757 by Antonio Diniz da Cruze Silva, the Portuguese Boileau, and other promoters of the revival of learning. It became extinct in 1776 and was replaced in 1779 by the Royal Academy of Sciences of Lisbon. Toward the close of this century two writers appeared who have formed schools, Francisco Manoel do Nascimento (1734–1829), an elegant lyrist, and Barbosa du Bocage, who introduced an affected and hyperbolical style of writing, which has been called, from the pen-name Elmano, which he adopted, *Elmanism*.

In the 19th century the classic school was represented by the followers of Manoel do Nascomento, Domingo Maximiano Tores and Ribeiro do Santos. Among poets of the century possessing some claim to originality are Roque, Carvalho Moreira, Mouzinho de Albuquerque, Feliciano de Castilho, Herculano de Carvalho, Almeida Garret, João de Lemos, Antonio de Serpa and Palmeirim. Through the efforts of these and other Portuguese literature has again begun to assume an aspect of native vigor. The drama has also been revived by J. B. Gomez, Pomenta de Aguiar, Mendes Leal and A. Herculano. Alexandre Herculano and Rebello da Silva are also writers of history and historic romance. Castello Branco is a novelist. To the Coimbra School, which found inspiration in the leading writers of modern France and Germany, belong the lyric poet João de Deus, the historian Theophilo Braga, the philologist Coelho and other less-known writers. Science, law and political economy are likewise well represented.

Portuguese literature is also cultivated with considerable independence and success in Brazil. For an extended discussion of Portuguese-Brazilian literature see section *Brasil* in the article WEST INDIAN, CENTRAL AMERICA AND BRAZILIAN LITERATURE.

Art.— The principal architectural monuments which Portugal possesses are due to the Goths and Moors. There are also numerous architectural relics of the Roman dominion, such as the ruins of an amphitheatre at Lisbon, those of a Corinthian temple dedicated to Diana at Evora and a round tower named after Sertorius. The cathedrals of Coimbra and Braga and the church of Cedofeita at Oporto are due to the Goths. The châteaux of Pombal, Feira, Alcobaça, etc., were palaces inhabited by the Saracen princes. There are no native works of any importance. Although the art has been well patronized Portuguese painters are few and have never formed a recognized school; the same may be said of native sculpture.

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PORTUGUESE MAN-OF-WAR, a pneumatophone or air-sac, often seen floating on the ocean, supporting or carrying suspended below a colony of *Physalia*. They are usually found floating in tropical seas, but in the latter part of summer often seen off the southern coast of New England. The float is an oblong, crested bladder, flattened on the lower side, from which are pendent the various individuals of the colony. The gaseous contents of the air-sac or bladder appear to be under the control of the individual, so that it can sail awash or submerged like a submarine. The long filaments, sometimes trailing out to a distance of fully 20 feet, have batteries of nettle-cells numerous and powerful enough to paralyze fishes, and cause much discomfort to human beings, even when the organisms in question are dead on the beach. See SIPHONOPHORA.

PORTUGUESE WEST AFRICA. See AFRICA.

PORTULACA, a genus of annual and perennial herbs of the family *Portulacaceæ*. The species, of which about 20 have been described, are natives of warm and temperate climates and are mostly American. They are often trailing, have fleshy stems, usually thick leaves and generally terminal flowers followed by small conical capsules containing numerous tiny seeds. The flowers open in sunshine but close in shade. The two best known species are *P. grandiflora* and *P. oleracea*. The former is widely cultivated in gardens for its very showy but ephemeral flowers which have a wide range of color. The hottest, dryest, sunniest places and light soils suit the plant well. It is a native of Brazil. The other species is said to be a native of Persia, where it was used as a potherb more than 2,000 years ago. It is also said to be indigenous in the southwestern United States. Popularly known as pusley and purslane, it is one of the commonest weeds in warm and temperate climates upon light loamy and sandy soils, but rarely upon heavy. It has several improved varieties which are cultivated, especially by the French, for greens.

PORTUNUS, pôr-tū'nŭs, or **PORTUMNUS,** Roman god of harbors. He corresponds to the Melicerta or Palæmon of the Greeks and was originally the god of doors, symbolized and represented with a key in his hand. He had a temple on the Tiber where his festival, the Portunalia, was annually celebrated on 17 August.

PORUS, king of India: d. 317 B.C. He was of ancient and noble lineage, and his kingdom occupied the north of India between the Hydaspes and Acesines. When Alexander invaded India in 326 B.C. he found the army of Porus barring his further passage at the Hydaspes. After considerable delay Alexander succeeded in fording the river higher up in its course, but was met by Porus and a terrific battle ensued, in which the Indian king was wounded and taken prisoner. Brought before Alexander his noble bearing aroused the admiration of the conqueror and they became friends and allies. Alexander extended the kingdom of Porus to the Hyphasis and when he retired from India left him as ruler of the enlarged kingdom. Porus seems to have extended his domain still further after the death of Alexander, but in 317 B.C. was assassinated by the satrap Eudemus.

There appear to have been two other Indian rulers of the same name. One of these was a nephew and an enemy of the great king, and the other a king of Madura, on friendly terms with the Emperor Augustus. Consult McCrindle, ‹Invasion of India by Alexander the Great› (1896); Macdonell, ‹History of Sanscrit Literature› (London 1913).

PORY, pŏr'ĭ, John, English colonist: b. England about 1570; d. there, before October 1635. He was graduated from Gonville and Caius College, Oxford, in 1592, studied under Hakluyt and in 1619–21 was secretary to Sir George Yeardley in Virginia. His accounts of his excursions among the Indians are published in Smith's ‹Generall Historie.› He returned to England in 1621, but in 1623 was appointed commissioner of the privy council, resided in Virginia for another year, and the remainder of his life appears to have been spent in England. His letters are in the British Museum. He translated ‹Geographical Historie of Africa, written in Arabicke and Italian by John Leo, a More.›

POSADAS, a name given in Mexico to the nine consecutive days' celebration immediately preceding Christmas day. From their nature the posadas would seem to have originated in a miracle play employed to teach the Indians the story of the birth of Christ. The Aztecs were accustomed to hold a year-end celebration of five days (an aboriginal week), beginning on or about 16 December. The Spaniards held another from 22 to 24 December. As it was impossible to suppress the Indian heathen celebration, the Catholic Church extended the Christian festival to cover the nine days of the posadas.

POSEIDON, pō-sī'dŏn, in Greek mythology the lord of the sea, identified by the Romans with the Italian deity Neptune. He was a son of Cronus and Rhea, and hence a brother of Zeus, Hades, Hera, Hestia and Demeter. His usual residence was in the depths of the sea near Ægæ, in Eubœa, where he had a palace, and kept his horses, with brazen hoofs and golden manes. He is called the earth-holder or earth encompasser, as the sea surrounds the earth, and the earth-shaker, as the earth is shaken by the waves of the sea beating on the shore. He is the ruler of all other marine deities and of all animals that live in the sea. He gathers clouds and raises storms and allays them. In several myths he is represented as contending with some land divinity for the possession of particular spots of earth. The horse, and more particularly the war-horse, was sacred to Poseidon, and one of the symbols of his power. The other well-known symbol of his power is the trident, or three-pronged sceptre. During the Trojan War Poseidon was the constant enemy of Troy. The cause of this enmity was the ingratitude shown him by Laomedon, the second king of Troy, and the builder of the walls of the city. Poseidon had numerous offspring by mothers divine and human. The worship of Poseidon was common throughout Greece and the Greek colonies, but especially prevailed, as is natural, in the maritime towns. The animals sacrificed to him were horses and bulls, sometimes also wild boars and rams. The Isthmian games, and the Panionia or festival of all the Ionians, celebrated near Mycale, were held in his honor. In works of art Poseidon is represented with features resembling those of Zeus, but he has not the calm majesty of the supreme god, although he is more powerfully built. When represented standing, he always bears the trident in his right hand and a dolphin in his left. (See NEPTUNE). Consult Farnell, L. R., ‹Cults of the Greek States› (Vol. IV, 1907).

POSEN, pō'zĕn, Germany, (1) a fortified town in Prussia, capital of the province and government of the same name, on the river Warthe, 149 miles east of Berlin and 103 north of Breslau. Fort Winiary, adjoining the town, serves as the citadel. It is a railway centre, enjoying an active trade also by water. Of its public edifices the chief are the Roman Catholic cathedral and the parish church, the former having the splendid "golden chapel" attached; the archiepiscopal palace; the town-hall, a Renaissance building mostly of the 16th century; the Raczynski Library; the Mielzynski Museum, the archæological museum and library, the real-gymnasium and two other gymnasia (one Protestant and one Roman Catholic), an academy, normal and other schools, hospital, a theatre and some elegant private mansions. The manufactures consist chiefly of agriculture and other machines, carriages, artificial manures, etc. There are also large breweries and distilleries. Posen is the see of an archbishop, the residence of a provincial governor and the seat of important courts and numerous public offices. It was one of the oldest and most important towns of Poland, and its inhabitants still largely consist of Poles. It was at one time allied with the Hanseatic League. It is one of 10 fortified cities of the first class in Germany and has underground and wire connections with the nearby fort of Geogau. It was a Russian objective in their advance in 1914–15. Pop. about 156,691. (2) An eastern grand duchy and province of Prussia, bounded north by West Prussia, east by Russian Poland, south by Silesia and west by Brandenburg; area, 11,186 square miles. The surface is generally flat and extensively occupied by lakes and marshes. A small portion belongs to the basin of the Vistula, which touches it on the northeast; the rest belongs to the basin of the Oder, which receives its drainage through the Warthe in the south and centre and the Netze in the north. The soil is for the most part light and sandy, and considerable tracts are covered with heath; many parts are covered with a rich alluvium or vegetable mold, yielding all the ordinary species of grain, millet, flax, hemp, tobacco and hops. The pastures are extensive and feed numerous herds of cattle, horses and swine; considerable attention is paid to the rearing of poultry, particularly geese, and also to the rearing of bees. The minerals, comparatively unimportant, include bog iron-ore, saltpetre, limestone and building-stone. The manufactures consist chiefly of spirituous liquors, woolen stuffs, linen and leather. The trade in these articles and in horses and swine is considerable; other exports are corn, cattle, tallow, leather, honey, wax, goose-feathers and hogs'-lard. There are 1,200 miles of railway in the province. The inhabitants include a considerable mixture of Germans and Jews, but the great majority are Poles, Posen being one of the acquisitions which Prussia made by the dismemberment of Poland. It is divided into the two governments of Posen and Bromberg and has been subjected to a representative rule to overcome disaffection. It is represented in the Imperial Reichstag by 15 members and in the Prussian Landtag by 29 delegates in the lower and 19 in the upper chamber. As part of Poland, Posen was divided into the palatinates of Poznania, Gnesen and Inowraclaw. At the first partition of Poland in 1772 the district of the Netze fell to Prussia, and the remainder in the second partition of 1793. Between 1807 and 1815 Posen formed part of the grand duchy of Warsaw, but in the latter year reverted to Prussia. Pop. 2,099,831.

POSEY, pō'zĭ, **Alexander Lawrence**, Creek Indian educator, journalist and poet: b. near Eufaula, Okla., 3 Aug. 1873; d. 27 May 1908. His father was a white man of Scotch-Irish descent, born about 1842 in the Indian Territory, being the child of white intruders in the Cherokee Nation. His mother was a Muskogee Indian of unmixed blood. Until he was 12 years old, Alexander Posey spoke only the language of his mother's people. Then his father, who was in independent circumstances, employed a private teacher and compelled the son to learn to speak and write English. A year or two later he was sent to the public (tribal) school at Eufaula. When he was 17 he entered Bacone Indian University at Muskogee, where he acted as librarian, learning to set type on *The Instructor*, a small paper published by the faculty, and discovered his own bent for literary work. In October 1892 he published 'The Comet's Tale,' a lengthy poem relating to the Indian tradition of the coming of the first ships of the white men to discover America. Immediately after his graduation, in 1895, he entered public life, being elected a member of the Creek House of Warriors, the popular branch of the tribal legislative council. In 1896 he was appointed superintendent of the Creek Orphan Asylum at Okmulgee. A year later he became tribal superintendent of schools, but held it only a short time, resigning to settle on his farm near Stidham. There he continued to write as inspiration prompted. He was pre-eminently a poet of nature and loved the solitudes of which he wrote. Then he was called back to educational work as superintendent of the Creek National High School at Eufaula, with a brief term of service at a similar institution at Wetumka, but soon relinquished that work to take charge of the publication of the *Indian Journal* at Eufaula. There he found his literary opportunity, developing marked ability as a satirist. His inimitable "Fus Fixico" letters, in which he humorously discussed the white man's politics through the medium of dialogues between fictitious characters who were typical of the older and more conservative Creek full-blood element — Wolf Warrior, Hot Gun and others — who talked in the broken Creek-English dialect, were widely copied in States far from Oklahoma, where the force of their satire could not be appreciated because its object was unknown. Because of his sympathetic understanding of the uneducated people of his tribe, whose interests were jeopardized in the readjustment incident to the allotment of lands in severalty, he gave up newspaper work to become a field agent of the allotting commission, in which position he rendered valuable service. In 1905 he was chosen a delegate to the Sequoyah Constitutional Convention, which met at Muskogee, and of which he was elected secretary. The simple, terse, clear English of the instrument framed by that convention was said to have been largely due to his writing and revising. He met death by drowning in the

North Canadian River. A volume of his poems was published after his death.

POSEY, Thomas, American soldier: b. eastern Virginia, 9 July 1750; d. Shawneetown, Ill., 19 March 1818. He was quartermaster in Lord Dunmore's expedition against the Ohio Indians and was engaged in the battle at Mount Pleasant in 1774. In 1775 he was a member of the Virginia committee of correspondence and raised a company of which he became captain for the 7th Virginia Continental Regiment. He assisted in defeating Lord Dunmore at Gwynn's Island in 1776; in 1777 joined the Continental army at Middlebrook, N. J., and with his company was transferred to Morgan's renowned rifle-corps, where he played a conspicuous part in the engagement at Piscataway, N. J. He served with great gallantry under Gates at the battles of Bemis Heights and Stillwater, and in 1778 was promoted major and had charge of the expedition against the Indians of Wyoming Valley in that year. In 1779 he commanded a battery under General Wayne at Stony Point and was one of the leaders in the assault which carried the enemy's works. He was present at the surrender of Yorktown, organized a regiment of which he was given command with the rank of lieutenant-colonel, and served under General Wayne in Georgia until the surrender of Savannah, where he routed the Indians under Gueristersigo. After the war he lived in Spottsylvania County, Va., until 1793, when he was appointed brigadier-general and served under General Wayne in his campaign against the Indians in the Northwest. He resigned in 1794, settled in Kentucky, entered the State senate and was ex officio lieutenant-governor. He raised a company of which he was for a time captain in the War of 1812, and in 1812–13 he served as United States senator from Louisiana. He was governor of Indian Territory from 1813 until her admission into the Union as a State and from 1816 until his death was Indian agent.

POSIDONIUS, pō-sĭ-dō'nĭ-ŭs, Greek Stoic philosopher: b. Apamea, Syria, about 135 B.C.; d. after 51 B.C. He studied at Athens under Panætius of Rhodes, after whose death in 112 he presently established himself as a teacher at Rhodes, whence he is called the Rhodian. He taught the Stoic philosophy with great applause, was at the same time a statesman and one of the Prytanes, and went at 50 as an ambassador to Rome. The most distinguished Romans were his scholars, and Cicero was initiated by him into the Stoic philosophy. He wrote many works on history, astronomy and geography, now lost. In his physical investigations he was more nearly a follower of Aristotle than of the Stoic school, the members of which he greatly excelled in this department of knowledge. Fragments of his writings were edited by Bake (1814), and by C. Müller in 'Fragmenta Historica Græcorum' (1849). Consult Ritter-Preller, 'Historia Philosophiæ Grææ' (1913).

POSILIPO, pō-sē-lē'pō, or **PAUSILIPPO**, pow-sē-lē'pō (Latin, *Pausilipona*), Italy, a hill and grotto to the southwest of Naples, the grotto furnishing a passage from that city to Pozzuoli. This grotto, or tunnel, leads directly to the village of Fuorigrotta; its height is about 70 feet, and the breadth 21 feet. It was long supposed that it was earlier than the time of the Romans, but it is now supposed to date from the time of Augustus or Tiberius. It was widened in 1442 by Alphonso I, plastered by Pietro of Toledo, and again repaired in 1754 by Charles III. Since 1885 there has been a second «grotto,» about 150 feet longer, which is more commonly used, as is also a road over the mountain built in 1822. On the hill above the grotto is the famous Tomb of Virgil. To the south is Cape Posilipo. The town of Posilipo on the hill has about 4,500 inhabitants.

POSITIVE, that which is active, affirmative, known, virile, definite, strenuous; opposed to negative, which is quiescent, receptive, unresponsive, indefinite. The word has many specific senses: (1) In electricity, the active pole, from which a current is regarded as flowing. (2) In photography, a picture so taken that the lights and shades appear naturally, which is opposite to a negative, in which they are reversed. (3) In optics, a lens that shows a view naturally instead of upside-down. (4) In general, that one of two opposite things which is regarded as primary or active. (5) The thing that is known, can be seen clearly or sensed readily. (6) An adjective, characterizing a dogmatic person, who «always knows he is right.» It is also applicable to the manly nature, as opposed to the womanly, feminine or negative, nature.

POSITIVISM, pŏz'ĭ-tĭv-ĭzm, originally denotes any theory that takes the affirmative side and states its tenets in positive terms. In this sense one speaks of positive Christianity or positive theology, as synonymous with dogmatism, indicating thereby that liberal religion which rejects belief in miracles, or a special revelation, or the traditional Church doctrines, is negative.

The term was appropriated by August Comte to denote a philosophy that would limit itself to the positive sciences and exclude all metaphysical speculation. Comte propounded positivism as the ultimate aim of the evolution of knowledge, which (as Turgot had indicated) necessarily passed through three stages, the theological, the metaphysical and the positive. In the theological stage, the classified phenomena of nature are personified as gods — a view based upon a mythological interpretation of nature which reaches its climax in minotheism and leads to the metaphysical stage in which the laws of nature are conceived as impersonal essences or powers. The highest and last stage is attained when the scientist is satisfied simply to describe the facts and leave out all metaphysical speculation.

Comte felt that there was something wrong with metaphysics, and he eliminated it from the domain of his philosophy, but instead of solving the problem, he ignored it on the plea that it was unsolvable. His great work 'Philosophie Positive' (consisting of six volumes) contains simply a recapitulation of the whole range of human knowledge, the systematic arrangement of which he called the hierarchy of the sciences. Comte does not deny the existence of something metaphysical, but only maintains that research in this domain is fruitless.

Eugen Dühring, a German philosopher of great acumen, rightly criticizes Comte's positivism in saying that «its main contents, strangely enough, consist in negativism,» and “a hierarchy of the sciences offering a digest of knowledge cannot pretend to be philosophy.» (Krit. Gesch. d. Phil. p. 486).

In a more advanced stage of his life, Comte felt the need of going beyond the standpoint of the positive sciences. In response to this need of his nature he invented a religion of mankind which should be based on science, replacing the idea of God by the conception of ideal mankind. Comte's conception of a scientific religion is worthy of a great genius, but the rituals which he prescribes are too artificial, and proved acceptable only to a very limited circle of his admirers.

Littré, the well-known author of a French dictionary, disavowed Comte's religion as fantastic, but he accepted his philosophy which he formulated as follows: «The domain that lies beyond refers to the things that cannot be known. Positive science proposes neither to deny nor to affirm them. In a word, it does not know the Unknowable, but it recognizes its existence. This is the highest philosophy. To go beyond is chimerical, to go not so far is to miss the mark.»

The most prominent English representative of Comtean positivism, George Henry Lewes, sums up the tenets of positivism in this sentence: «Our province is to study her (nature's) laws, to trace her processes, and, thankful that we can so far penetrate the divine significance of the universe, be content — as Locke wisely and modestly says — to sit down in quiet ignorance of all *transcendent* subjects.»

The modern representative of Comte's positivism in England, averring both his philosophy and his religion, is Frederick Harrison, president of the English Positivist Committee, and author of ‘Positive Evolution of Religion’ (New York 1913).

In spite of the shortcomings of Comte's philosophy, the conception of positivism is a great and recommendable ideal; but positivism in order to fulfil its purpose should be truly positive. Genuine positivism would be a philosophy based upon the facts of experience. Whether or not metaphysics is wrong depends entirely upon the definition of the word. If «the metaphysical» is a mysterious essence or power behind nature, the scientist should not merely ignore it but deny its existence; but if, after the precedence of Aristotle, we understand by metaphysics «the science of first principles,» we must grant that its study, far from being fruitless, is indispensable for every scientist.

The aim of a positive philosophy should be to understand the methods and general spirit of science, to systematize the results of the totality of human knowledge and to apply them to practical life. Accordingly, philosophy will serve three purposes: it will be (1) the propædeutics (preliminaries) of science, (2) a synopsis of all knowledge and (3) ethics or the science of moral conduct. The first branch of philosophy includes logic, epistemology and methodology, that is, the sciences which are equally needed as intellectual tools in all the several branches of inquiry. The second part, a synopsis of all knowledge, cannot be a mere compendium or a hierarchy of the sciences, but must be worked out into a systematic world-conception, not a mere sum of the sciences but their product, which might be called «ontology,» that is, the science of existence or «cosmonomy,» the science of the world constitution. Ontology in the old sense is an a priori construction of a system of abstract thought; in the new sense it would be a methodical arrangement of the facts of experience, a monistic or consistent system of knowledge. Cosmonomy explains the prevalence of uniformities and their formulation as general rules, called laws of nature, etc. It points out the permanent background of existence, the eternal conditions of becoming from which world-systems originate and, above all, defines man's position toward the whole of existence, toward his fellows and especially toward those factors that determine his destiny — in religious nomenclature called «God.» The third part of philosophy would be a practical application of the second, resulting in what has been called philosophy proper, world-wisdom or, broadly speaking, ethics. Consult Huxley, Thomas, ‘Scientific Aspects of Positivism’ (in ‘Lectures and Lay Sermons,’ Everyman's Library, 1910).

PAUL CARUS,
Editor of ‘The Monist.’

POSSE COMITATUS, pŏs'ē kŏm-ĭ-tā'tŭs, in law, the force of able-bodied male citizens whom the sheriff by the common law is authorized to call to his assistance in case of invasion, rebellion, riot, breach of the peace, forcible resistance to process, etc., in the county or district in which he holds office. All persons included in the posse comitatus are bound, under penalty of indictment, to assist the sheriff when lawfully called upon and are justified in killing a person in case of resistance. Unnecessary violence on their part, however, is punishable.

POSSESSION, a legal term, which has come to have a larger meaning than in common usage of the word or the primary sense, from Latin *possideo* — to sit upon. It has grown to mean something distinct from mere custody. It is defined as the detention and enjoyment of a thing which one holds and exercises by oneself or through another in his name. It is the condition by which a person may exercise power over a thing at his pleasure and to the exclusion of all others. There are two requisites to complete possession: first, occupancy, and second, the taking with intent to possess — hence persons who are without legal wills — as children, idiots, etc., cannot acquire possession; however, a child of sufficient understanding may legally acquire possession of a thing.

One is said to be in actual possession when the thing is in immediate occupancy and constructive possession when one claims to hold by virtue of a title without actual occupancy; possession may be enjoyed by the proprietor of a thing — thus the proprietor of a house possessing it by his tenant. A thief may have a thing he has stolen, but he does not rightfuly possess it. One who borrows his friend's horse has it in his custody, but is not a legitimate possessor.

To acquire possession of a property it is requisite that there be intention of possessing as owner and also the possession of the thing.

Possession is lost when one transfers a property to another with the intention of divesting himself of the title or when he does some act which manifests his intention of abandoning possession. Though, of course, no proof of ownership or title to property or a thing, the possession is a fact in evidence of it and it is sufficient evidence against anyone who cannot show a better claim. Continuous possession of land for a time, which varies in the statutes of various jurisdictions, usually 20 years, will give the occupant title by adverse possession. With chattels a replevin suit is often instituted to regain custody, when the goods are illegally withheld from the rightful owner. See BAILMENT; TITLE; REPLEVIN.

POST, Alfred Charles, American surgeon: b. New York, 13 Jan. 1806; d. there, 7 Feb. 1886. He was graduated from Columbia in 1822 and from the College of Physicians and Surgeons in 1827. After two years' further study in Paris, Vienna, Berlin and London he established a practice in New York, in 1831–35 was demonstrator of anatomy in the College of Physicians and Surgeons, in 1836 became an attending surgeon at the New York Hospital and throughout his life continued his connection there, occupying at his death the office of consulting surgeon. He was appointed professor of ophthalmic surgery at Castleton Medical College, Vt., in 1843, and of surgery in the following year. In 1851–75 he was professor of surgery in the University of the City of New York, vice-president of the New York Academy of Medicine in 1861–66 and its president in 1867–68, president of the Pathological Society and for many years was connected with Saint Luke's, the Presbyterian and the Women's hospitals. He conducted a weekly clinic at the University Medical College in New York, for many years, was the first surgeon in the United States to perform an operation for the cure of stammering and was the inventor of several valuable surgical instruments and appliances. Besides numerous medical papers contributed to scientific journals, he published ‹Strabismus and Stammering› (1840) and ‹Observations on the Cure of Stammering› (1841).

POST, George Browne, American architect: b. New York, 15 Dec. 1837; d. 28 Nov. 1913. In 1858 he was graduated at New York University and in 1859–60 studied architecture under the direction of Richard M. Hunt. In the Civil War he was commissioned captain of the 23d New York Volunteers and at the end of the war had risen to the rank of colonel. In 1865–67 he practised as an architect in New York with Gambrill and thereafter independently. He became one of the most successful of American architects of the late 19th century. Among his works are the old Equitable building, Produce and Stock exchanges, the World building and City College buildings in New York; also the residence of Cornelius Vanderbilt in the same city, the Prudential building, Newark, N. J., Liberal Arts building, Chicago, the Wisconsin State Capitol, etc. He was a member of several societies, a chevalier of the Legion of Honor (1901), member of the National Academy of Design and of the National Commission of Fine Arts.

POST, George Edward, American missionary: b. New York, 1838; d. 1909. In 1860 he was graduated in medicine at the University of the City of New York and in the following year at Union Theological Seminary. He was appointed to the chair of surgery at the Syrian Protestant College of Beirut, where he remained until his death. He was an accomplished linguist and wrote several Arabic works, including ‹Flora of Syria, Palestine and Egypt›; ‹Textbook of Botany›; ‹Textbook of Mammalia›; ‹Textbook of Birds›; translation of Butler's ‹Physiology›; ‹Concordance to the Bible›; ‹Textbook of Surgery›; ‹Textbook of Materia Medica›; ‹Dictionary of the Bible.›

POST, Melville Davisson, American lawyer and novelist: b. Harrison County, W. Va., 19 April 1871. He was graduated from the University of West Virginia and has since practised law in Grafton, W. Va. In 1898 he was chairman of the Democratic Congressional Committee of West Virginia. He has published ‹The Strange Schemes of Randolph Mason› (1896); ‹The Man of Last Resort› (1897); ‹Dwellers in the Hills› (1901); ‹The Gilded Chair› (1910); ‹The Nameless Thing› (1912).

POST, Wright, American surgeon: b. North Hempstead, N. Y., 19 Feb. 1766; d. Throgg's Neck, N. Y., 14 June 1828. He received his medical education in New York and London and in 1786 established a practice in New York. In 1792 he was appointed professor of surgery at Columbia, where he later occupied the chair of anatomy and physiology, afterward holding the same chair in the Medical School of New York. For 35 years he was consulting surgeon in the New York Hospital, president of the College of Physicians and Surgeons in 1821–26, and was prominently connected with numerous medical societies. He made himself famous by his surgical achievements, many of which were departures from the old school.

POST-NUPTIAL CONTRACT. See LAW OF HUSBAND AND WIFE.

POST-OBIT BOND, a mode of contracting loans sometimes resorted to by heirs and others who expect a legacy on the death of some third party. The condition in the bond is, that the sum borrowed shall not be exigible till that party's death; and hence, not only in consequence of the uncertainty of the event, but also sometimes in consequence of the uncertainty of the succession itself, which may be contingent, and perhaps never be realized, the creditor usually makes very exorbitant terms.

POST-OFFICE. See POST-OFFICE DEPARTMENT.

POST-OFFICE CLERKS, United National Association of, an association formed in 1890, for the purpose of securing, through legislation and other means, the classification of post-office clerks with a view toward securing more equitable salary rates, regulation of hours of labor and other similar objects. The organization also issues death benefit insurance policies.

POST-OFFICE DEPARTMENT. The official title of one of the executive departments of the government; established in 1794. It is under the management of the Postmaster-General, who since the time of Andrew Jackson has been a member of the President's Cabinet.

He is appointed by the President and confirmed by the Senate. The department is divided into four great bureaus each under the immediate charge of an assistant postmaster-general. The first assistant's bureau has charge of the large clerical and carrier forces and all the matters of actual management. It supervises an annual expenditure close to $100,000,000. The bureau of the second assistant has the immense task of providing for the transportation of the mails at a yearly cost of about $80,000,000. That of the third assistant looks after the financial side, furnishes the stamps and keeps the accounts. The fourth assistant has charge of the appointment of 55,000 postmasters and directs the force of inspectors.

The Railway Post Office.— The idea of a railway post office was first brought officially to the notice of the department of First Assistant Postmaster-General Hobbie, who, in 1847, had been in Europe, and in his report gave his impressions of the traveling post office in England. Under Postmaster-General Holt, in July 1862, the first railway post office was introduced in this country. In 1864 the leading railroads were induced to alter the cars for the purpose of the railway post office, and from that time this service has grown, until now it is a model institution of its kind. In 1916 there were 3,479 railway routes, 8,027 mail messenger routes, 571 electric car routes, 264 wagon routes, 260 steamboat routes, 21 star routes (in Alaska), and six pneumatic tube routes. The cost of the railway mail service was $28,516,000, and railway mail pay $61,692,000.

Money-Order System.— The money-order system was established in 1864, under the administration of Postmaster-General Blair. In order to accommodate soldiers and others wishing to transmit small sums of money, he advised the incorporation of this idea in our postal system. At its beginning only 138 offices were allowed to issue orders. The number increased to 34,547, which during 1903 issued 45,941,681 domestic money-orders, and in 1917, 133,292,000 domestic orders, and 1,973,714 foreign orders, this latter a decrease due to the war. See POSTAL MONEY ORDER SERVICE.

Rural Free Delivery.—The rural free delivery service was established under President McKinley, in 1897. That year 44 routes were put in operation. The service has grown steadily. By 1901 the mileage had grown to over 100,000, the cost was $1,750,321, and over 15,000 carriers were employed. In 1905 the mileage was 721,237, cost $20,864,000, with 32,055 carriers. In 1910 the mileage was 993,068, cost $36,915,000. with 40,997 carriers. In 1917 the mileage was 1,112,556, cost $52,420,000, with 43,338 carriers. The net advantage of the Rural Free Delivery system include (1) postal receipts increased; (2) value of farm lands enhanced; (3) farmers brought into touch with markets; (4) social and educational benefits derived in country and town by being kept in touch through the daily receipt of papers and correspondence; (5) benefits to small towns. In three, at least, of these advantages the benefit of the postal service to commerce is distinctly notable. See PARCEL POST.

Dead Letter Office.— The dead letter office dates back to 1825. An act of Congress made it the duty of postmasters to publish quarterly, or oftener, whenever the Postmaster-General might direct, a list of letters remaining in their offices, and once every quarter to forward those that could not be delivered to the department at Washington. Here are received annually about 15,000,000 pieces of mail matter.

The Postal Union.— Under the terms of a treaty concluded at Berne, 9 Oct. 1874, the object of which was to secure uniformity in the treatment of correspondence, and the simplification of accounts, as well as the reduction of rates within certain limits, and whose provisions were carried into operation generally 1 July 1875, the whole of Europe, the United States, Egypt, British India and all the colonies of France were at the outset, or shortly thereafter, included in the union, and many other countries and colonies have since joined it. The international accounts in respect of postages are based on a month's return of correspondence taken every third year.

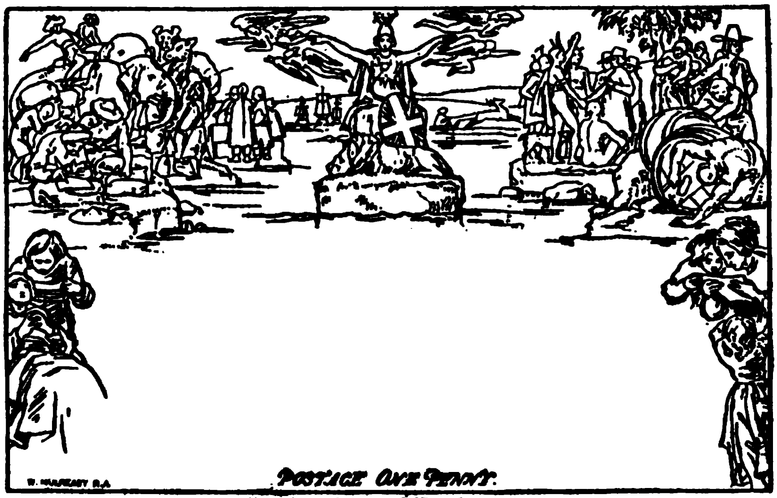
Postal Savings Banks were established by the Postal Savings Act of 25 June 1910. See BANKS AND BANKING; POSTAL SAVINGS BANKS and POSTAL SAVINGS SYSTEM.

Increase of Rates.— In November 1917 the law for increased postage for war revenue went into effect, and first class mail, drop letters and post cards were raised one cent each. The rate on magazines containing over 5 per cent advertising was also increased, according to zones of delivery. Former rates restored 1919.

Post-Office Statistics.— In the United States in 1789 there were only 75 post offices established, the length of the post routes being 2,275 miles and the gross revenue of the department being only $7,510. The expenditures for the same year were $7,560 and of this only $1,657 were paid in salaries to postmasters. In 1875 there were 278,000 miles of postage routes, a revenue of $27,000,000, with expenses of nearly $34,000,000. In 1900 there were 428,000 miles of post routes, a revenue of $110,000,000, and expenses of $120,000,000. The total number of post-offices was reduced from 74,169 in 1903 to 55,413 in 1917, rural free delivery causing the dropping of small offices. There were in 1910, 59,580 post offices in operation, 447,998 miles of post routes, 553,312,998 miles of mail service performed. The gross revenues of the department were $224,128,657.63, the expenditures $229,977,224.50, and $27,521,013.29 were paid as compensation to postmasters. In 1917 these figures had grown to 55,413 offices, 479,487 miles of post routes, $329,726,116 revenue, and $319,838,718 expenditure. In 1911, 1913, 1914, 1916 and 1917 the post office showed a profit, and it is the policy of the department to continue making a slight profit. From June 1847 to June 1851, 4,603,200 postage stamps were issued, while in the single year 1910, 11,360,353,679 stamps were used by the people of the United States. In 1853, the year in which stamped envelopes were first issued, 5,000,000 were used, while in 1910 the total was 1,506,861,593. The first year's issue of postal cards — 1873 — numbered 31,094,000, while in 1910 726,441,000 were issued. The registry system was started in 1854, and in that year the registered pieces numbered 629,322. In 1910 they numbered 42,053,574. In 1865 money-orders to the amount of $1,360,122 were issued, while in 1910 the total amounted to $647,736,327, and in 1917 it was

$855,000,000. The number of pieces of matter of all kinds mailed increased from 500,000 in 1790 to about 20,000,000,000 in 1919. For further information see PHILATELY; POST AND POSTAL SERVICE; STAMPS, POSTAGE; and related references.

POST-PLIOCENE, that division of geologic time and the strata laid down in it which follows immediately after the Pliocene. The term has been used as designating all that period from the end of the Pliocene till now, in which sense it is equivalent to Quaternary (q.v.) or, by some geologists, as applied only to the earlier portion of this period, in this sense being equivalent to Pleistocene (q.v.).


POSTAGE ONE PENNY.

Earliest British Postal Envelope (1840).

POST AND POSTAL SERVICE. The word post is derived from the Latin *positus,* meaning «placed,» because horses were put or placed at certain distances to transport letters or travelers. From this ancient beginning, the post has developed into one of the most effective instruments of civilization. In the Old Testament are frequent references to the posts. In 2 Chron. one will find: «So the posts went with the letters,» and «So the posts passed from city to city.» In Esther, also, and in Job and Jeremiah one will find other allusions to the posts. But they were never for the use of the common people. The first recorded postal system was in the Persian Empire. According to Xenophon, Cyrus the Elder caused couriers, with saddled horses, to stand ready at different stations throughout the empire, situated one day's journey from each other, in order to receive reports from the provinces without delay. In the time of Julius Cæsar the service of couriers in the parts of the Roman dominions under his government was so well organized that of two letters which he wrote from Britain to Cicero at Rome, the one reached its destination in 26 and the other in 28 days. Such services, however, were only established by governments or persons in authority for their own use. Private persons, in their intercourse with one another, had to employ slaves to convey their letters to destination, or to trust to the chance of finding some person who was going to the place to which the letter was addressed, and was willing to undertake the delivery of it. The Emperor Diocletian, at the end of the 3d century, appears to have been the first to establish a postal system for the benefit of private persons. At later dates Theodoric the Great, Charlemagne and others had well-organized services for communication with all parts of their empire.

Early History of the Public Post.— The earliest postal system was established in France by the University of Paris. From the end of the 13th century this institution maintained couriers, who at certain times took charge of letters and money for the students collected in that city from almost all parts of Europe. Louis XI established for his own use mounted messengers, and by an edict of 19 June 1464 instituted post stations on the chief roads of France. This system was continued under the following reign, and ultimately private persons began to make use of the royal couriers for the transmission of their own correspondence. During the reign of Louis XIII the French system of posts received a more regular form from the establishment of a comptroller-general of posts.

In Germany the first post was established in Tyrol in the latter half of the 15th century, by Roger I, count of Thurn, Taxis, and Valsassina. His son established another from Brussels to Vienna in 1516, by the wish of the Emperor Maximilian I. In 1522 a post was established between Vienna and Nuremberg, and Charles V, anxious to have news as quickly as possible, on account of the vastness of his states, caused Leonard of Thurn and Taxis to establish a permanent riding-post from the Netherlands through Liège, Trèves, Spire and Rheinhausen, through Württemberg, Augsburg and Tyrol to Italy.

The postal system of Italy began in Piedmont. Until 1561 the transmission of letters was in the hands of the communes or private persons, who were authorized by the state to charge for the service a sum which varied according to circumstances. In the year mentioned the posts were farmed out by Emmanuel

Philibert, Duke of Savoy, to a postmaster-general. This arrangement continued until 1697, when Duke Victor Amadeus II added the proceeds of the post office to the revenue of the state, an indemnity being paid to the postmaster, who had the contract for them. From 1710 downward the post office was administered directly by the state.

The British Post.— There were private posts in England from the time of Edward III. In 1635 a public post was established between London and Edinburgh. In 1644 Edmund Prideaux, then a member of the House of Commons, was appointed master of the posts, and first established a weekly conveyance of letters into all parts of the nation. In 1683 a penny post was set up in the metropolis. During the government of William III acts of Parliament were passed which regulated the internal postal system of Scotland; and, by the ninth act of Queen Anne, the postal system of England was arranged on an improved footing. A general post office was instituted at London for the British dominions with chief offices at Edinburgh, Dublin and other places, while the whole system was placed under the control of a postmaster-general with power to appoint deputies for the chief offices. At this time the letter rate of postage was eight cents for 15 miles or under, with a rising scale to 25 cents for 300 miles. In 1837 Sir Rowland Hill inaugurated a movement for reform in the postal service. Penny postage resulted in 1839, and on 6 May 1840 the first postage stamp, designed by W. Mulready, was first brought into use. In the same year the money-order system was adopted and in 1848 the book post was established. In 1855 pillar letter-boxes were introduced, and London was divided into 10 districts, for greater facility in the distribution of city letters. The British post-office system developed rapidly after 1860, and has long included a parcels post and banking and telegraph systems. The service is under the immediate control of the Postmaster-General, assisted by the chief secretary of the post office in London. There are also chief officers in Edinburgh and Dublin. The Postmaster-General is a member of the Privy Council, and sometimes a Cabinet minister. In 1915 there were 24,509 post offices in the United Kingdom and 50,285 road and pillar letter-boxes. The total number of letters delivered during the year was 3,409,000,000.

The Colonial Post in America.— In the American colonies the post office made its first appearance in Massachusetts in 1639, when the General Court of that colony issued the following: «It is ordered that notice be given that Richard Fairbanks, his house in Boston, is the place appointed for all letters, which are brought from beyond the seas, or are sent thither, to be left with him, and he is to take care that they are to be delivered or sent according to direction: and he is allowed for every letter a penny, and he must answer all messages through his neglect of this kind.» In 1657 a postal service was established in Virginia. The colonial law required every planter to provide a messenger to convey the dispatches, as they arrived, to the next plantation, and so on, on pain of forfeiting a hogshead of tobacco for default. In 1672 the government of New York established a mail to go monthly between New York and Boston. In 1674 the General Court at Hartford enacted laws to regulate the postal services in the colony. In July 1683 William Penn established a post office in Philadelphia, with weekly mails to various places near the city, and about the same time opened mail routes between Philadelphia and the larger towns of Pennsylvania and Maryland. These represent the several colonial enactments in relation to postal communication.

Neale's American Post.— The beginning of the American post proper dates with the signing of a patent 17 Feb. 1691 vesting in Thomas Neale the American post. On 4 April following, Neale and the Royal Postmaster-General appointed Andrew Hamilton postmaster-general of America. Hamilton undertook the arduous duty of establishing an intercolonial post. He visited all the colonies, was trusted implicitly and satisfied each colony of his ability and resources in the new venture. The co-operation of all the colonies except Virginia having been secured, services began on 1 May 1693, and consisted of a weekly post from Portsmouth, N. H., to Boston, Saybrook, New York, Philadelphia, Maryland and Virginia. Five riders were engaged to cover each of the five stages twice a week. In winter, service was performed fortnightly. Hamilton died in 1703, and his son, John Hamilton, succeeded him. In 1707 the Crown purchased the good will of the American post office and continued John Hamilton as postmaster-general. From 1707 to the year before the Revolution the General Post Office in London controlled the service in America. In 1711 there was a weekly mail operation between Boston and Main, and fortnightly exchange between Boston and New York. In 1717 the mail ran weekly between New York and Williamsburg, Va., and 10 years later there was a fortnightly mail between Philadelphia and Annapolis, Md. The period of activity in the establishment of postal facilities began when Benjamin Franklin was appointed postmaster at Philadelphia in 1737. At the request of the deputy postmaster-general for the colonies, he assisted him in the regulation and management of the various post offices then established, and when that official died, in 1753, Franklin, in company with William Hunter, was appointed to succeed him. In consequence of some difficulty with Governor Hutchinson of Massachusetts, Franklin was removed in 1774.

The United States Post.— The Continental Congress met at its second session, in Philadelphia on 26 July 1775, and its members resolved to have a post-office system of their own, and Franklin was elected to carry on the work. A salary of $1,000 a year was voted him. However, Franklin's great diplomatic talents secured him soon afterward a transfer to a wider field, and in 1776 his son-in-law, Richard Bache, was appointed to succeed him. Mr. Bache was succeeded in 1782 by Ebenezer Hazard, who had, in 1775, been the «constitutional postmaster» of New York, so termed to distinguish him from the British deputy at that place. The Colonial Congress in 1782 passed an act authorizing the postmaster-general to establish a line of posts between New Hampshire and Georgia, and to such other places as Congress might direct and to appoint the necessary deputies, for whose faithfulness and honesty he was to be held accountable. On 8 May 1794 the Congress passed the first law for the proper management of the postal service. In 1799 the postal laws were revised, and flogging substituted for the death penalty for robbing the mails. This law, however, was repealed by a subsequent enactment, and imprisonment for a term of years made the penalty. The office of Second Assistant Postmaster-General was created in Madison's administration, and the scale of postage changed. Single letters — that is, containing one piece — were charged from eight to 25 cents, according to distance. The Sunday delivery at post offices began in 1810, bringing forth vigorous remonstrances from various religious bodies, and the strife was kept up in Congress and occupied the attention of the Department for 20 years. In 1813 the mails were first conveyed in steamboats from one post town to another. The postal laws of 1816 made a change in the postage, which lasted until 1845. The new scale charged for letters, consisting of one piece of paper, not going over 30 miles, six cents; not over 80 miles, 10 cents; not over 150 miles, 12½ cents; and not over 400 miles, 18¾ cents; and for greater distances, 25 cents. The success of the postage stamp in Great Britain led local postmasters in a number of United States cities — notably New York, Baltimore, Saint Louis, Providence and New Haven — to issue stamps. They proved popular, and in 1847 the United States introduced stamps and the 5 and 10-cent denominations, with the faces of Franklin and Washington respectively. Previously the postage was collected entirely in money, its prepayment being in all cases optional. On 1 July 1851 a new series of stamps was adopted, consisting at first of denominations of one and three cents, but afterward of larger amounts. Stamped envelopes were first used in 1853. The registration system was instituted in 1854, during the administration of President Pierce. The first fee was five cents; the price was raised in 1863 to 20 cents. It is now ten cents. In the administration of President Lincoln the free delivery service was established. As early as 1825 provision was made by Congress for the delivery of letters by carriers at a cost of two cents each to the persons receiving them. In 1836 this was further amended by allowing newspapers and pamphlets to be delivered at half a cent each. In 1863 Postmaster-General Blair introduced the free delivery system, beginning the practice in cities of 50,000 population. Receiving boxes were also put up and deliveries provided for as often as the public convenience demanded. The postal card was introduced in 1873. For the further development of postal service see POST-OFFICE DEPARTMENT and related references.

POST-RENAISSANCE PAINTING, painting as practised in Europe after the middle of the 15th century.

Seventeenth Century.— The great color school of monumental and decorative painting which was the glory of Venice was one of the last to disappear (see RENAISSANCE PAINTING). Paris Bordone (q.v.), a pupil of Titian, did little to maintain it, but a much more vigorous and original talent was that of Jacopo Robusti (1518–94), called Il Tintoretto from his father's occupation as a dyer, and also surnamed Il Furioso from his manner of working. The number of his paintings was very great, and their merit very unequal. From the school of Verona, which had been for some time rising in importance, and even in the 15th century had produced some painters of note, came another illustrious artist to add to the fame of Venice, Paolo Cagliari (q.v.), called Paolo Veronese (1532–88), one of the most brilliant of all decorative painters. The school of Bologna was founded by Lodovico Carracci, aided by his two cousins, Agostino and Annibale, in 1589, at the period of the rise of the Electric school, protesting against the Mannerists, and of the *naturalisti*, rejecting all tradition and professing to study nature directly. In Naples appeared an Hispano-Neapolitan school of which the chief was Jusepe Ribera, called Lo Spagnoletto. Spain produced a number of native painters in the 15th and at the beginning of the 16th century; and the influence of Italian art became more predominant toward the middle and at the close of the latter. But the authority of the Inquisition was strongly restrictive. Francisco de Zurbaran (q.v.) (1598–1662?) was preeminently a painter of monks. The three great names in Spanish art are Alonzo Cano (q.v.) (1601–67), a pupil of Francisco Pacheco, the master and also the father-in-law of Velasquez; Diego Rodriguez de Silva y Velasquez (q.v.) (1599–1660); and Bartolome Estéban Murillo (q.v.) (1618–82). The name of Velasquez has been raised by modern criticism to the summit of the art of painting. In Germany, no painter attained the eminence of Dürer and Holbein for more than two centuries; after them, a baleful imitation of the mannerisms of the Italians suppressed any assertion of national individuality, and the so-called inspiration from Michelangelo affected even foreign painters visiting in Germany,— as the Hollanders Goltzius, Hubert and Hendrick. The works of Adam Elzheimer (1578–1620), though he visited Italy and died in Rome, displayed a curious and original talent, both in figures and landscape, unusual at this period.

But it was to the Netherlands that the chief seat of the art of painting was transferred in the 17th century, made illustrious by the great development of all resources of the art; the influence of Peter Paul Rubens (q.v.) (1577–1640) not only revolutionized the schools of painting of his era but is still felt in those of our day. One of the most celebrated of his pupils was Anton Vandyck (q.v.) (1599–1641), whose portraits constitute his chief title to eminence; another was David Teniers the elder (q.v.) (1582–1649), instructor of his still more famous son of the same name. In the works of the latter, and of a number of the painters of Holland, Adrian Brauwer (q.v.), Adrian Van Ostade (q.v.), Jan Steen (q.v.), Gérard Terburg (q.v.), Gabriel Metzu (q.v.), Gérard Dow (q.v.), is carried to the highest point the genre painting of contemporary life, the *extériorité*, which so strongly differentiates this Northern art from that of Italy. In the painting of landscapes, animals, marines and even still-life, this excellence of technique was also maintained, reaching its supreme development in the genius of Rembrandt (q.v.) (1607–69), the greatest master of light and darkness of any school of painters. Under François I, a number of Italian painters were induced to visit France, many of them being employed in the decorating of the palace of Fontainebleau, and their influence prevailed strongly for nearly two centuries. The art of the 17th century was largely the official art of Louis XIV and of his court painter, Charles Lebrun (q.v.); one of the most important events was the establishment of the Academy of Painting and Sculpture at Paris in 1648. A much more graceful and idyllic art was introduced by Nicholas Poussin (q.v.); and the classic landscape by Claude Gelée, called Claude Lorrain (q.v.). In England, also, foreign artists, in this case French, Flemish and even Greek, were largely employed before the reign of Henry VII (1485–1509), in painting miniatures on glass, enamels, etc. The example of Henry VIII in encouraging the great Holbein was followed by his successors,— Mary Tudor employed Antonio de More (Antonio Moro); Elizabeth, Lucas de Heere and Frederico Zuccari; Charles I, Rubens and Van Dyck; Charles II, Peter Lely, of Soest in Westphalia, and Godfrey Kneller of Lübeck. The only English names that assume any importance in these annals are those of Isaac Oliver, his son Peter, Samuel Cooper, a pupil of Van Dyck, Robert Streator, Henry Anderton and Peter Monamy.

Eighteenth Century.— During the 18th century the art of the Netherlands passed into an eclipse, recognized, and deplored, by the national historians, and that of Germany into another, which was long hailed as a "revival." Belgium, the battle-ground of Europe for so many years, exhausted and ravaged under its constantly changing rulers, could furnish no encouragement to the arts, and the painters, like those of Holland, with a very few exceptions, abandoned their own initiative and the study of native art for the servile imitation of the works of their predecessors,— the portraitists and the figure painters, such as Rubens and Lebrun; the landscapists, like Poussin; the battle painters, like Philips Wouwerman (q.v.), etc. In Germany, the revolt against the general decline was called the Classic Movement, the first of the three great epochs into which this revival is divided, and which is dated from the arrival of Raphael Mengs (q.v.) in Rome, in 1741. The future leaders in the second phase of this movement, Cornelius, Overbeck, Veit, Schadow, etc., were all born in the very last years of the century. Great Britain and France, on the contrary, developed, in a number of distinct schools each, fresh evidences of a national and original art, in practically all the branches of painting. In portraiture, the British record the names of Reynolds, Gainsborough, Romney and Raeburn; in genre, not always satiric, Hogarth — one of the most pre-eminently national of all artists, and Wilkie; in landscape, Gainsborough, Old Crome, Constable and Turner. In academical and historic art, the Americans, Copley and West, rose to international eminence. In France, the last days of the monarchy were made illustrious by the delicate and graceful courtly art of Watteau (q.v.), Pater, Lancret and Fragonard, the frail idylism of Greuze (q.v.) and the admirable naturalism of Chardin (q.v.) — to be succeeded in their turn by the pedantic "classicism" of David and the Empire. This century is distinguished also by the growing recognition of the popular interest in art, encouraged by the opening of royal galleries and the dissemination of engraving. Three female painters appear, whose graceful talents entitle them to recognition,— in Venice, Rosalba, Carriera (q.v.) 1675–1757); in Germany, Angelica Kauffmann (q.v.) (1741–1807); and in France, Mme. Vigée-Lebrun (q.v) (1755–1842). In Italy, the last glories of the Venetian school flamed up in the daring and truly decorative work of Giambattista Tiepolo (q.v.) (1696–1770).

Nineteenth Century.— During the 19th century the supremacy in painting and sculpture was transferred to France; Paris, with its annual official Salons, became the recognized capital of the fine arts for Europe and America. French art in this century has been considered to have passed through three great periods, corresponding closely with changes in the national government,—Classicism, Romanticism and the third period, dating from 1848, the schools of the Second Empire and the Third Republic. All these have naturally had many subdivisions. The classicism of Louis David (q.v.), with its sacrifice of everything in painting to the outline and to what was considered to be an imitation of the antique, was obliged to yield gradually to the Napoleonic art, representations of battles and of state ceremonies, and to genre painting,— the last not being officially recognized till 1816. Classical painting, which dominated in Europe for 50 years, was almost exclusively figure painting; its rigid formalism gave way to a greater sympathy with nature even in the works of David's immediate pupils and followers, Regnault (q.v.), Picot (q.v), Baron Gérard (q.v.), Gros (q.v.) and Ingres (q.v.). And much more living and sympathetic classic taste than David's was that of Prud'hon (q.v.). Romanticism found its first expression in painting in the works of Géricault (q.v.), though Delacroix (q.v.), more emotional and more of a colorist, is considered to have been the leader. The essential narrowness of this form of art was also gradually tempered by naturalism, so that its range became wider,— as in the very different art of Decamps (q.v.), first of the Orientalists, and of Ary Scheffer (q.v.) and Paul Delaroche (q.v.). Landscape painting began to assume that great importance which it has ever since maintained in modern art, and the way was opened for the famous Fontainebleau school of Corot (q.v.), Rousseau (q.v.), Troyon (q.v.), Diaz (q.v.), Daubigny (q.v.) and Jules Dupré (q.v.), in which the painting of cattle is also raised to its highest eminence. The school of the peasant — as it might be called — which has played so large a part in contemporary painting, both of France and of all the nations whose students have imbibed French methods and conceptions, permits of such a wide range of treatment as that between the very frank realism of Courbet (q.v) and the "hieratic gloom" of Jean-François Millet (q.v.). Somewhere between these extremes are the rural scenes of Lhermitte (q.v.) and those of Jules Bréton (q.v.), in which realism is tempered with a certain style, with a strong desire to avoid the merely commonplace.

The latter half of the 19th century saw the rise of so many and so widely differing movements and tendencies in French painting that no general classification is possible. Under the Second Empire the official art, that of the

Académie and the Institut, included such celebrated names as those of Gérôme (q.v.), Jules Joseph Lefebvre (q.v.), Bonnat (q.v.), Cabanel (q.v.), Baudry (q.v.), Bouguereau (q.v.) and Henner. In Genre, characterized usually by excessive delicacy and accuracy of finish, the highest place was held by Meissonier (q.v.); and but little inferior was the work of Louis Leloir and Vibert (q.v). Something of the haunting antique influence appears in the work of Gleyre, Couture (q.v.) and Flandrin (q.v.), protesting against the rising flood of «realism»; something also in that of the so-called Neo-Grecs, of which the two most sincere and persistent were Hamon (q.v.) and Aubert. The most graceful of the Orientalists was Fromentin (q.v.), and the painters of Eastern subjects, in very varying methods, include many of the most celebrated names of this epoch, Gérôme, Henri Regnault (q.v.), Benjamin-Constant (q.v.), Belly, Boulanger and others. Of the mystical school, uninfluenced by any conventions or traditions, the most striking example is that of Gustave Moreau (q.v.); and one of the most distinguished and honored of the older men is Hébert (q.v.), whose delicate, melancholy art has not varied since 1850. Nearly all the French figure painters are portraitists. Military subjects have been rendered with a realistic accuracy and a dramatic force never before attained, by Yvon (q.v.), Detaille (q.v.), De Neuville, Aimé Morot, Roll and others; mural painting received a new inspiration from Puvis de Chavannes (q.v.); a warmer splendor of color than that of the Venetians was revived by Monticelli (q.v.); and the still-life of the early Dutch painters equaled by that of Dosgoffe and Vollon (q.v.) One of the most important manifestations of this contemporary school was that of the Impressionists (q.v.), with their new theories of presenting absolute realities, and of which the most uncompromising advocates among the leaders were Manet (q.v.), Monet (q.v.), Sisley, Pissaro, Caillebotte, and others. While the influence of this innovation still lingers, the contemporary art of the Salons shows but very little trace of it. It is to be noticed that the great decline in all artistic value of these annual Salon exhibitions, and of the national art generally, within the last 10 years, has been admitted by the French themselves.

In Great Britain, the influence of the Pre-Raphaelite movement of 1851 is considered to be still very strong, especially among the younger painters, but it is certain that that of the Newlyn school, much later, and even of the Glasgow school in landscape painting, has had very much more to do with the introduction of more purely artistic conceptions and a much sounder technique. A few of these younger colorists, as La Thangue and Clausen, have been officially recognized by the Royal Academy (q.v.), and the works of a number of the others, as Edward Stott, Alfred East, Alfred Parsons and J. M. Swan, the animal painter, appear at its annual exhibitions. Unlike the Pre-Raphaelites, who advocated the distinctly moral purpose of art — rejecting all but the sincerity and truth-seeking methods of Raphael's predecessors, and unlike the conventional characteristic art of the day with its insistence upon details and a subject, these modern innovators paint the simplest themes with breadth and with skilful rendering of atmosphere and color. At the head of the academical school stands the name of Sir Frederick Leighton, afterward Lord Leighton (q.v.); his immediate successors in the office of president, Sir John Everett Millais (q.v.) and Sir Edward J. Poynter (q.v.), sustain intelligently the traditions of an art whose greatest defect is generally in the brush-work. All forms of painting are represented in this school, historical, decorative, portrait, genre, landscape and marine. The British water color school has long been considered to be one of the most important branches of the national art; it likewise includes all subjects in its province and treats them with much the same seriousness of detail as the oil-painting. The most important of the official bodies after the Royal Academy are the Royal Scottish and the Royal Hibernian academies, and there are many minor societies representing various tendencies of the art.

Unlike England or France, northern Germany has never possessed one recognized centre of the arts — the conflicting claims of Berlin and Munich being mutually disallowed; but in Austria, the capital, Vienna, has long enjoyed this distinction — in the 18th century and in the 19th more particularly since the aggrandizement of the city following the razing of the outer walls in 1858. This period gave rise to a species of electicism in all the arts, in which a great variety of styles and influences prevailed. In Prussia and Bavaria, the second period of the great revival, led by Cornelius and Overbeck, began about 1810; and the third — the natural reaction against the mysticisms and devoutness of these «Nazarites» (q.v.), and hence considered to be naturalistic — about 1830. Still another regeneration is placed immediately after the close of the war of 1870–71. The development of this latter, however, was slow; the real leader in the modern movement is considered to be Franz Stück (q.v.), who first became widely known at the exhibition in Munich in 1889. This movement was particularly directed against the academic formulas of the historic painters of the school of Piloty (q.v.) and the rural genre of Defregger (q.v.) and Vautier (q.v.). Much of the influence of the older men, however, still survives and among those who escaped this general denunciation was the veteran, Menzel (q.v.). The three great «Secession» movements were those of Munich, Düsseldorf and Berlin, but the art of the latter capital is still largely official. The secession in Austria and the division of the painters into «the old and the new» dates from only about 1897. In Hungary, the national art, rising from the exhaustion and devastation of the numerous wars and revolutions, is considered to have taken form after the Revolution of 1848.

Contemporary Continental painting may be said to have been so greatly influenced by the art of France as to have fallen into a routine in which mere technical skill very frequently takes the place of any strong national or individual assertion. This is particularly true of Italy, Spain and Portugal. In the former, the Neapolitan painters, the chief of whom are Palizzi, Morelli and his pupil, Michetti, are the most interesting and the best known abroad; about 1887 a society of Roman painters was formed to combat the commercial art of the day, for which Fortuny (q.v.) was considered to be largely responsible. Among the few painters with international reputations, two of the most prominent are Segantini and Madame Romani-Carlesimo. In Spain, also, but few traces are left of the brilliant Roman-Spanish school (q.v.) of Fortuny, even in the genre. In much broader methods all the brilliancy of the contemporary cosmopolitan technique appears in the luminous canvases of Sorolla y Bastida (q.v.), and what are considered to be the qualities of Goya in the somewhat brutal scenes of daily life by Zuloaga. Dignified historical art is worthily represented by Pradilla (q.v.); and the small Venetian scenes painted by Rico are widely known. Portuguese art has suffered from many national ills; the list of contemporary painters is headed by the king, Dom Carlos I.

Painting in the Netherlands has not followed common lines of development in Holland and Belgium — in the latter, it has been susceptible to every new wind of doctrine from abroad, while the Dutch artists have remained faithful to what may be defined as the national principles for the last 30 years. This close appreciation of nature, the sense of the essential and intimate quality of things, differs from the famous national art of the 17th century, both in conception and in technical processes, but it seems to be rather an evolution than a revolution. The leaders in the movement against the undiscriminating assimilation of all other European methods, which prevailed in 1830, were Josef Israëls (q.v.) and Jacobus Maris (q.v.); the renown of the latter is shared by his two brothers, Matthys and Willem. The landscapes of Jongkind, Willy Martens, Blommers and Anton Mauve, the marines of Mesdag, the domestic genre of Albert Neuhuys, the church interiors of Bosboom, have given this art an international renown. Among the younger painters, a not very important independent movement was set on foot within the last few years — that of the «New Impressionists,» seeking the expression of greater vehemence, of more passion, in their works. The leaders in this were Isaac Israëls, the son of Josef, and Georges Hendrik Breitner. In strong contrast with this national art is that of a few denationalized painters who have gone abroad — as Kaemmere, in Paris and Alma-Tadema in London. The somewhat undiscriminating revolt against all the old traditions in Belgium was inaugurated by the founding of the Société libre des Beaux-Arts in 1868, followed by various associations, publications, manifestations and «discoveries.» So widely divergent are the principles of the modern school, however, that they include the historical paintings of Baron Leys (q.v.), the marines of Clays, the powerful and gloomy renderings of the life and labor of the poor by Constantin Meunier and the impressionism of Evenpoel, resembling that of the Spaniard Zuloaga. Of the mystical and imaginative painters, the most reticent and refined is Fernand Khnopff; one of the so-called realists, very hard in design and color and sacrificing all tones and values, is Léon Fréderic.

Scandinavian art, also, shows divergencies, following national characteristics — that of Norway being ruder, somewhat more direct; that of Sweden following more faithfully the varying currents of foreign art, as does the scanty art of Finland; that of Denmark, seemingly more intimate, with comparatively little variety. The emancipation from foreign domination, mostly German and latterly French, is recent and is not yet complete, dating in Denmark from the commencement of the 19th century, under Thorwaldsen (q.v.) the sculptor and Eckersberg the painter; and in Norway from only about 1890. The sound technical training that permits of the rendering of even the distinctively northern themes, the clear, cold, impressive aspects of nature, the sincere and intimate domestic genre, has in nearly all cases been acquired in foreign schools — Norway and Finland having none of their own; and of the most brilliantly equipped of these painters, as the Swede, Zorn (q.v.), and the Norwegian, Thaulow, it is to be said that their art, like their celebrity, is cosmopolitan. Many of the artists trained in Paris have identified themselves with the contemporary French school — the Norwegians generally excepted. Among the few painters who have remained distinctly national, one of the most original and most decorative in his work is Carl Larsson of Sweden; Gerhard Munthe of Norway, a good landscape painter, owes his international reputation to his very curious and novel renderings of ancient legends.

The art of Switzerland, like the best of all that of the minor countries, even the South American and the Danubian, reflects strongly the influence of the Parisian schools. In Basel, however, in 1897, was celebrated a double festival in honor of Holbein and Böcklin (q.v.), the latter a painter whose art was singularly free from all traditions whatever.

The art of western Europe was first introduced into Russia by Peter the Great; before him it was barbaric, or semi-Byzantine, like the civilization. The Saint Petersburg Academy of the Arts was founded by the Empress Elizabeth in 1757. In its curriculum the imitations of the various European schools of painting were taken up in turn, or simultaneously, from Carracci and Guido Reni to the classicism of David and Mengs. The reaction against these has naturally developed a number of painters who strive to give expression to the sympathy with their own race or their own ideals; many of them share the depression, the pessimism, which characterizes so much of the contemporary literature. This affects strongly the landscape sentiment, even in the works of artists who have returned from studying abroad. Of these figure painters, the most important are Répin, Wasnetzoff, Serof and some others, the first named being one of the boldest of the realists of any school or time. Verestchagin (q.v.) is well known abroad by his very numerous and very large canvases in which he has sought to depict the horrors of war. In the Russian school are included the two Finnish painters, Edelfelt, whose figures and portraits are rendered with all the excellence of Parisian technique, and Axel Gallen, whose strikingly original paintings depict weird scenes in the national legends. Of the painters of Poland, the most widely known are Matejko and Josef Brandt (q.v.).

In the United States, painting has developed along the lines of technical excellence, rather than in any striking or inspiring development of a great distinct national art. Even in the matter of technique, some of the early portrait painters, as Gilbert Stuart (q.v.) and the wood-engraver, A. B. Durand (q.v.), remain unsurpassed. Trumbull (q.v.) and Washington Allston (q.v.) were not only portraitists but also painters of historical and imaginative compositions, the former excelling in the small heads in his large historical canvases, and the latter displaying more of a painter's feeling for tone and color. The art of Benjamin West and C. R. Leslie belongs rather to England and is to-day quite alien. The modern landscape may be said to commence with the pictures of the visionary Thomas Cole (q.v.), and is rapidly developed in the work of the painters of the «Hudson River School,» the most important of which were J. F. Kensett (q.v.), Sandford R. Gifford (q.v.), W. Whittredge (q.v.) (d. 1910), T. A. Richards (d. 1900) and Jervis McEntee (q.v.). The great panoramic canvases of Albert Bierstadt (q.v.) and the far more distinguished landscape compositions of Fred S. Church (q.v.), have no reflection in the work of to-day. This landscape art has culminated apparently in the renderings of tone and atmosphere, and the sentiment of nature in her quieter moods, in the works of such artists as George Inness (q.v.), Homer Martin (q.v.) and A. H. Wyant (q.v.) (d. 1892), and, of the stronger moods, Winslow Homer (q.v.), a painter of the clearest insight and most truthful rendering. William Page (q.v.) (d. 1885) and Daniel Huntington (q.v.) (d. 1906), each in his turn president of the National Academy of Design, enjoyed very considerable reputations as portrait painters, the former devoting himself to an effort to discover the secret of the color of the Venetians. At the present day, Blakelock, Ryder, Horatio Walker, Murphy, Dewey and Dearth represent the imaginative school of landscape; with them may be placed the more literal canvases of Tryon, R. Swain Gifford (d. 1905), Chase, Picknell, Bolton Jones and Theodore Robinson (d. 1896) — to mention only a few of a very long list. The portrait painters are also numerous; John S. Sargent (q.v.) enjoys an international reputation as one of the greatest of any school; Whistler (q.v.) (d. 1904; who resided in England), Eastman Johnson (d. 1906), Brush, Chase, Alexander (d. 1881), Vinton, Collins (d. 1903), George Butler, Wyatt Eaton (d. 1896), Beckwith, Tarbell, Benson, Vonnoh, Metcalf, Wiles and Fowler (d. 1910), at home, are among the most distinguished, as is Miss Cecilia Beaux. Most of these also paint genre, or semi-decorative figure pieces; some of them having commenced as illustrators, or still practising that art. Among the latter are Howard Pyle (d. 1911), A. B. Frost, W. T. Smedley and Hopkinson Smith (d. 1915). E. A. Abbey (q.v.) (d. 1911), originally an illustrator, had transferred his residence to England and painted both in historical and in large mural compositions.

John La Farge (q.v.) is in a way a link between the old and the new, having been a pupil of Couture, and the first, practically, to seek color for its own sake, in oil, in his very numerous water-colors and in his later monumental work both on walls and in stained glass. Another of the older men, Robert Weir (d. 1889), was noted for his important figure compositions, apparently influenced by the European schools; Alden Weir renders much simpler scenes in methods somewhat more affected by wholly modern processes; Thomas Moran, mountain landscapes and Venetian scenes inspired by the English painters of the early part of the century. A number of the figure and landscape painters have established themselves in Paris, MacEwen, Melchers, Julius Stewart, Edwin Lord Weeks (d. 1903), Johnston and others; Hitchcock in Holland, Ulrich in Germany, etc. The list of marine painters is also long; among the most talented are Arthur Quartley (q.v.) (d. 1886), Henry Snell, T. W. Richards, C. T. Chapman and some others, and, among the older men, James Hamilton (d. 1878).

In figure painting there has seemed to be a lack of popular appreciation for anything more ambitious than small examples of genre, usually familiar and domestic themes, rather than for the historic or the more purely imaginative or mystical — the most important exceptions of late years being the dignified, almost monumental canvasses of Abbot Thayer, and the Oriental interiors of Siddons Mowbray. The increasing use of large mural paintings in public and private buildings has, however, developed a school of truly decorative artists, of which the first in point of time was Wm. Morris Hunt, Frank Millet (d. 1912); the living painters are Mowbray, Dewing, Simmons, Blashfield, Vedder, C. Y. Turner, Robert Reid and a few others.

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WILLIAM WALTON,
Painter; Author of ‘Chefs-d'Œuvre, Exposition Universelle,› Paris.

POST-TERTIARY PERIODS, the last main division of the Geological Record, and which includes all the formations accumulated from the close of the Tertiary Periods down to the present day. No sharp line can be drawn at the top of the Tertiary groups of strata. On the contrary, it is often difficult, or indeed impossible, satisfactorily to decide whether a particular deposit should be classed among the younger Tertiary or among the Post-Tertiary groups. In the latter all the mollusks are believed to belong to still living species, and the mammals, although mostly of existing species, include some which have become extinct. These extinct forms are numerous in proportion to the antiquity of the deposits in which they have been preserved. Accordingly a classification of the Post-Tertiary strata has been adopted, in which the older portions, containing a good many extinct mammals, have been formed into what is termed the Pleistocene, Post-Pliocene, or Glacial group, while the younger deposits, containing few or no extinct mammals, are termed Recent. The Post-Tertiary periods are now generally termed Pleistocene and designate the units of geological time from the end of the Tertiary to the beginning of the Historic. This term was introduced by Sir Charles Lyell.

The gradual refrigeration of climate was prolonged and intensified in Post-Tertiary time. Ultimately the northern portion of the Northern hemisphere was covered with snow and ice, which extended into the heart of Europe, and descended far southward in North America. The previous denizens of land and sea were in large measure driven out, or even in many cases wholly extirpated by the cold, while northern forms advanced southward to take their places. The reindeer, for instance, roamed in great numbers across southern France, and Arctic vegetation spread all over northern and central Europe, and what is now the temperate zone of America. After the cold had reached its climax, the ice-fields began to retreat, and the northern flora and fauna to retire before the advance of the plants and animals which had been banished by the increasingly severe temperature.

The insensible gradation of what is termed the Pleistocene into the Recent series of deposits affords a good illustration of the true relations of the successive geological formations to each other. We can trace the gradual passage because it is so recent that there has not yet been time for those geological revolutions which in the past have so often removed or concealed the evidence that would otherwise have been available to show that one period or group of formations merged insensibly into that which followed it. The Recent formations are those which have been accumulated since the present general arrangement of land and sea, and the present floras and faunas of the globe were established. They are particularly distinguished by traces of the existence of man. Hence the geological age to which these belong has been spoken of as the Human Period. But there is good evidence that man had already appeared on earth during Pleistocene time, so that the discovery of human relics does not afford certain evidence that the deposit containing them belongs to the Recent series. Nevertheless it is in this series of the Post-Tertiary deposits that vestiges of man become abundant, and that proofs of his advancing civilization are contained.

During the Recent period the same agencies have been and are at work as those which have been in progress during the vast succession of previous periods. No trace can anywhere be detected of a break in the continuity of the evolution through which our globe has passed. See GEOLOGY (*Divisions of Geologic Time*) and consult the bibliography under that article. Consult also Fairchild, H. L., 'Pleistocene Geology of New York State' (in Bull. Geol. Soc. America, Vol. XXIV, Washington 1913).

POSTAGE STAMPS. See PHILATELY; POST AND POSTAL SERVICE; STAMPS, POSTAGE.

POSTAL MONEY-ORDER SERVICE. A governmental agency, operating through the post offices, to promote public convenience in remitting small sums of money, and to ensure greater security in the transfer of money through the mails.

Notwithstanding the fact that England has been successfully operating a money-order service since the year 1839, the need for such a facility in the United States does not appear to have been recognized until about 1857. On 31 January of that year Postmaster-General Campbell furnished the chairman of the Committee on the Post Office and Post Roads of the House of Representatives, on his request, with an outline of a plan for a postal money-order system such as might be put in operation in this country, but no action appears to have been taken in the matter. In the annual report of the department, dated 1 Dec. 1857, it was stated that the adoption of some method for the more convenient and safe remittance of small sums of money through the mails by means of orders had been frequently urged as a matter worthy of attention. The first definite recommendation made by the department, however, appeared in the annual report for 1862. Postmaster-General Blair in setting forth therein reasons for the exclusion as far as practicable of money from the mails recommended the adoption of a money-order system as one of the remedies for the evils resulting from the common practice of enclosing currency in letters.

No action having been taken upon the recommendation, it was renewed in the annual report of the department for 1863, Postmaster-General Blair expressing the opinion that such a system «would not only prove a great convenience to civilians and soldiers, but would almost entirely obviate the loss of many letters, the great majority of which enclose small remittances.»

The money-order service finally was authorized by Congress in the act approved 17 May 1864, and on 1 November of that year the system was put in operation. The service was inaugurated at 141 offices, which had been designated by the Postmaster-General in accordance with the authority conferred upon him by the money-order act. In making the selection of the new-fledged money-order offices, it was deemed expedient to designate first the larger post offices and then to extend the service to others as rapidly as possible. This method resulted in a register of 419 offices equipped for the transaction of money-order business at the end of the first year of operation.

Measures were early taken to extend the service to the army, and the fact that money-orders to the amount of $403,776.80 were drawn at the great centres of military operations during the first eight months of the system's existence is evidence of the extensive use to which it was put by the soldiers in sending money to their families and friends.

For a number of years following the close of the Civil War, the government itself was a patron of the system. Money-orders amounting to many thousands of dollars annually were issued on the application of the War Department for the payment of claims for bounty and back pay due by the United States to colored soldiers for services during the war, the organization of the money-order service rendering valuable assistance in insuring the proper payment of the claims.

One of the means provided by the act approved 13 June 1898 to meet expenditure caused by the Spanish War was the collection of a tax of two cents on each domestic order issued. The collections began 1 July 1898 and ceased 30 June 1901, by repeal of the law. During this period the system collected for and paid to the Internal Revenue Service $1,931,481.94, without any expense whatever to the Treasury Department and with practically none to the Post Office Department.

Aside from the ordinary service which it renders the citizen by affording him the practical result of a checking account in making purchases and settling financial obligations by mail, the money-order service of the United States is now used by the foreign-born population to send money to relatives and to the postal-savings banks in their own countries. Many persons in the past have found the money-order system a convenience for the temporary deposit of funds for safekeeping by having the order drawn on the office of issue and in their own names. The establishment of a postal-savings system in this country, however, served to reduce the amount of money sent to postal-savings banks abroad and to curtail the use of the money-order service for savings purposes.

The act of Congress establishing the money-order system limited the amount for which a single order could be issued to a maximum of $30 and a minimum of $1. It was stated by Postmaster-General William Dennison on 2 Nov. 1864, the day following the opening of the service, that «The limit of $30 is believed to be sufficiently large to include all that class of remittances now sent in money through the mails, but in exceptional cases more than one order can be procured.» As a basis for this statement it was shown that the average amount contained in «money» letters received at the dead letter office during the fiscal years 1862, 1863 and 1864 was $4.53, $4.20 and $5.18, respectively. However, before the service had completed its first year of operation, experience showed that so many applicants desired to send larger amounts through the mail that the labor imposed by the necessity of writing several orders to cover the remittances handicapped the economical operation of the system. This condition resulted in a recommendation to Congress by Postmaster-General Dennison on 15 Nov. 1865 for the increase of the maximum amount of orders to $50, which was accepted in the act approved 12 June 1866. The present restriction on the amount for which an order may be issued is $100. The reasons which led to this amount being fixed as the maximum were substantially the same as those already recited for increasing it from $30 to $50. The desirability of the present maximum was suggested as early as 1866, but it was not until 3 March 1883 that Congress authorized it.

The growth of the system and the continuous simplification of business methods are reflected in the reductions that have been made from time to time in the money-order fees, the principal source of revenue from the business. It is a noteworthy fact that with few exceptions the growing transactions of the system have permitted successive decreases in the charges to the public. These reductions were uniformly recommended to Congress whenever the receipts derived from the operation of the system were substantially greater than the expenses. The present low schedule is the result of the extensive patronage of the system by the public and the progress that has been made in handling the business economically.

It was prophesied by Postmaster-General Dennison on 2 Nov. 1864 that —

> **"The establishment of the (money-order) system in this country will no doubt lead to arrangements for the interchange of international money orders with the several foreign countries with which we have direct postal arrangements."**

This prediction was fulfilled on 27 July 1868 when the President signed an act authorizing the Postmaster-General to make conventions for exchange of orders with countries with which the Department had negotiated postal conventions. It was not until over a year later, however, that the first convention was concluded.

The service was initiated with Switzerland, pursuant to the terms of a convention signed at Washington on 2 July 1869 by the Postmaster-General, under the authority given by the act of 27 July 1868 and at Berne on 26 July 1869 by the chief of the Federal Post Department of Switzerland. The new service commenced on 1 Sept. 1869, 150 post offices in this country being authorized to issue and pay the international orders.

Service was next established with Great Britain on 2 Oct. 1871. Germany and Canada were the next countries with which conventions were concluded. The service has gradually been extended to other countries until at the present time conventions for the exchange of money orders exist with more than 50 foreign postal administrations.

The year 1880 saw important modifications in the terms of the original conventions with the United Kingdom of Great Britain and Ireland, the German empire and the Dominion of Canada. At the time the original conventions with these countries were concluded the value of United States currency was below par of gold and was continually fluctuating, which made it impossible for the issuing postmaster to draw the order for a fixed sum in the money of the country of payment and confined the actual exchange of orders between the respective countries to certain «international exchange offices.» The postmaster at the ordinary international money-order office would draw on the exchange office and the latter would make the conversion from the money of one country to that of the other at the market rate of gold prevailing in New York. When the currency of this country became stable, therefore, a simplification of the mode of procedure in the exchange of orders was made possible. Under the new method the postmaster at the inland international money-order office was able to issue the order for a determinate amount by the use of conversion tables supplied him. The rate of commission to be paid by each postal administration was lowered and the cost of the interchange of orders between the contracting countries was further reduced by the diminution of the number and cost of the blanks and the amount of clerical labor required. These economies permitted the United States to lessen materially the fees charged for the issue of orders to the countries concerned.

In line with the increase in the maximum amount of domestic orders to $100, which was authorized on 3 March 1883 the limitation on international orders was raised to a like amount by the act of Congress approved 30 Jan. 1889. Besides the advantage in uniformity between the two services that was gained by this legislation, the change tended to reduce the expense of the international system because only a single order was then required for sums from $50 to $100 instead of two orders as theretofore. Following is a table showing the growth of the service from the time of its inauguration in 1864 to the close of the fiscal year which ended 30 June 1918:

FISCAL YEAR	Number of money-order offices	Domestic money orders issued [1]		International money orders issued in the United States [2]		Postal notes issued [3]	
		Number	Value	Number	Value	Number	Value
1865	419	74,277	$1,360,122 52	....	....	....	....
1866	766	243,609	3,977,259 28	....	....	....	....
1867	1,224	474,496	9,229,327 72	....	....	....	....
1868	1,468	831,937	16,197,858 47	....	....	....	....
1869	1,466	1,264,143	24,848,058 93	....	....	....	....
1870	1,694	1,671,253	34,054,184 71	....	$22,189 70	....	....
1871	2,076	2,151,794	42,164,118 03	....	38,489 56	....	....
1872	2,452	2,573,349	48,515,532 72	41,812	833,006 00	....	....
1873	2,775	3,355,686	57,516,214 69	91,847	1,863,512 37	....	....
1874	3,069	4,420,633	74,424,854 71	112,614	2,265,242 32	....	....
1875	3,404	5,006,323	77,431,251 58	102,250	1,964,574 88	....	....
1876	3,401	4,998,600	77,035,972 78	109,409	2,068,668 03	....	....
1877	3,697	4,925,931	72,820,509 70	104,816	1,844,053 98	....	....
1878	4,143	5,613,117	81,442,364 87	120,788	2,047,696 86	....	....
1879	4,512	6,372,243	88,254,541 02	137,088	2,240,454 95	....	....
1880	4,829	7,240,537	100,352,818 83	221,372	3,463,862 33	....	....
1881	5,163	7,663,232	105,075,769 35	291,098	4,683,926 38	....	....
1882	5,491	8,420,869	113,400,118 21	377,443	6,536,514 48	....	....
1883	5,927	8,807,556	117,329,406 31	466,326	7,717,832 11	....	....
1884	6,310	7,835,694	122,121,261 98	478,148	7,688,776 53	3,689,237	$7,411,992 48
1885	7,056	7,725,893	117,858,921 27	448,921	6,840,358 47	5,058,287	9,996,274 37
1886	7,357	7,940,302	113,819,521 21	493,423	7,178,786 21	5,999,428	11,718,010 05
1887	7,853	9,232,177	117,462,660 89	615,405	9,035,530 31	6,307,552	11,768,824 81
1888	8,241	9,959,207	119,649,064 98	759,636	11,293,870 05	6,668,006	12,134,459 04
1889	8,727	10,130,140	115,081,845 79	824,427	12,280,516 67	6,802,720	12,082,190 73
1890	9,382	10,624,727	114,362,757 12	859,054	13,230,135 71	6,927,825	12,160,489 60
1891	10,070	11,451,274	119,122,236 50	923,896	14,443,667 47	6,802,558	11,753,849 28
1892	12,069	12,069,442	120,066,801 07	983,476	15,120,271 55	7,050,040	11,895,765 51
1893	18,434	13,309,735	127,576,433 65	1,055,999	16,341,837 86	7,753,210	12,903,076 73
1894	19,262	14,304,041	138,793,579 49	917,823	13,792,455 31	7,765,310	12,649,094 55
1895	19,691	22,031,120	156,709,089 77	909,278	12,906,485 67	....	....
1896	19,825	23,962,053	172,100,649 02	985,799	13,852,615 74	....	....
1897	20,031	25,169,055	174,482,676 94	944,185	13,588,379 33	....	....
1898	22,388	27,798,078	191,354,121 63	955,334	13,239,769 27	....	....
1899	26,784	29,007,870	211,213,592 84	968,501	13,744,770 37	....	....
1900	29,649	32,060,983	238,921,009 67	1,102,067	16,749,018 31	....	....
1901	30,529	35,586,379	274,546,067 34	1,247,888	20,072,613 65	....	....
1902	31,680	40,474,327	313,551,279 88	1,311,111	22,974,473 11	....	....
1903	34,547	46,229,354	357,851,458 32	1,626,476	31,014,125 14	....	....
1904	35,094	50,712,168	383,452,373 80	1,888,730	37,876,265 75	....	....
1905	36,832	53,722,463	401,916,214 78	2,163,098	42,503,246 57	....	....
1906	37,444	58,863,123	450,359,052 00	2,634,738	57,204,607 04	....	....
1907	37,572	62,530,408	486,478,146 65	3,179,511	77,252,907 05	....	....
1908	43,313	65,345,395	506,170,014 62	3,230,815	81,502,011 18	....	....
1909	50,043	69,304,395	498,511,747 14	3,175,014	69,317,899 97	....	....
1910	51,791	77,585,321	558,178,028 35	3,832,318	89,558,299 42	....	....
1911	51,809	81,906,206	590,034,432 52	4,060,431	97,681,211 85	....	....
1912	52,815	85,286,380	594,901,623 90	3,708,773	86,095,404 58	....	....
1913	54,594	91,412,698	636,814,179 46	3,850,310	90,703,205 12	....	....
1914	55,055	104,736,717	677,908,573 58	3,896,824	91,285,920 10	....	....
1915	55,670	105,728,032	665,249,087 81	2,399,836	51,662,120 65	....	....
1916	56,026	122,302,149	728,177,816 63	2,345,766	37,544,520 17	....	....
1917	56,170	133,291,973	822,679,622 83	2,798,465	32,284,182 85	....	....
1918	55,668	122,686,471	914,575,254 99	1,569,374	25,938,963 63	....	....

[1] Domestic money orders first issued, 1 Nov. 1864, under act of Congress approved 17 May 1864.
[2] International money orders first issued, 1 Sept. 1869, under act of Congress of 27 July 1868.
[3] Postal notes first issued, 3 Sept. 1883, under act of Congress approved 3 March 1883.

International money-orders are of two kinds — those issued on what is known as the «domestic basis» and the «international basis.» In the former class the orders are drawn on the ordinary domestic form and settlement is made between the two countries involved on the exchange of paid orders. In the latter class the orders issued in each country are recorded on descriptive lists at an exchange office designated for the purpose and accounts are settled on the basis of such lists, care being taken to give due credit to the country of origin for the amounts of orders not presented for payment within one year from the time of issue.

Following are tables showing money-orders exchanged between the United States and foreign countries during the fiscal year ended 30 June 1918:

Countries having postal money-order systems arrange themselves into two general groups:

1. The United States, Great Britain, her colonies, protectorates and dependencies, comprising Canada, the Commonwealth of Aus-

DOMESTIC BASIS.

COUNTRIES	United States domestic orders paid in foreign countries		Foreign domestic orders paid in the United States		Excess paid in foreign countries	Excess paid in the United States
	Number	Value	Number	Value		
Antigua	1,519	$17,676 10	689	$3,882 45	$13,793 65	
Bahamas	996	13,514 76	2,375	15,542 48		$2,027 72
Barbados	24,345	298,679 55	1,949	24,355 79	274,323 76	
Bermuda	1,748	22,705 13	2,494	19,415 93	3,289 20	
British Guiana	2,420	28,328 46	4,202	28,072 64	255 82	
British Honduras	187	2,119 68	5,999	51,298 19		49,178 51
Canada	549,418	7,684,738 36	1,637,758	17,020,944 52		9,336,206 16
Canal Zone	11,850	241,512 29	126,711	2,021,712 75		1,780,200 46
Cuba	21,859	405,854 43	116,090	1,438,047 80		1,032,193 37
Dominica	354	4,506 92	374	2,785 39	1,721 53	
Grenada	1,707	28,450 50	795	4,932 35	23,518 15	
Jamaica	32,760	357,565 63	2,689	40,170 95	317,394 68	
Martinique	84	1,138 45	132	8,001 40		6,862 95
Mexico			18	1,633 00		1,633 00
Montserrat	936	12,231 04	157	2,685 91	9,545 13	
Nevis	642	8,181 46	132	608 10	7,573 36	
Newfoundland	8,793	235,664 71	14,785	219,693 78	15,970 93	
Philippine Islands	13,955	430,629 84	60,494	1,054,087 03		623,457 19
Saint Kitts	1,667	34,905 54	316	2,539 09	32,366 45	
Saint Lucia	756	8,836 06	994	21,011 92		12,175 86
Saint Vincent	1,854	29,190 65	357	3,103 33	26,087 32	
Trinidad	4,095	58,489 21	4,131	28,629 19	29,860 02	
Virgin Islands	79	817 07	152	5,707 47		4,890 40
Total	682,024	$9,925,735 84	1,983,793	$22,018,861 46	$755,700 00	$12,848,825 62

INTERNATIONAL BASIS.

COUNTRIES	International orders certified for payment in foreign countries		International orders certified for payment in the United States		Excess certified by the United States	Excess certified by foreign countries
	Number	Value	Number	Value		
Australia	6,744	$138,036 14	20,670	$273,697 09		$135,660 95
Austria (no business)						
Belgium (no business)						
Bolivia	45	671 12	397	3,434 17		2,763 05
Chile	850	22,490 45	2,360	18,731 99	$3,758 46	
Costa Rica	350	6,120 67	343	2,938 48	3,182 19	
Denmark	24,487	404,072 69	2,609	66,855 16	337,217 53	
Egypt (no business)						
France	93,417	952,436 84	10,931	183,238 69	769,198 15	
Great Britain	794,107	9,652,443 59	112,191	2,067,879 12	7,584,564 47	
Germany (no business)						
Greece	5	373 04		04	373 00	
Honduras	59	1,024 63	17	172 17	852 46	
Hongkong	2,333	80,281 21	2,539	8,960 35	71,320 86	
Hungary	27	299 20			299 20	
Italy	275,585	5,400,923 28	1,708	26,268 35	5,374,654 93	
Japan	128,013	4,091,486 50	12,205	198,515 53	3,892,970 97	
Liberia	91	3,533 66	96	2,209 65	1,324 01	
Luxemburg	3	23 99	1	26 51		2 52
Mexico	4,707	124,986 77	913	12,515 61	112,471 16	
Netherlands	22,536	273,703 95	3,995	51,514 65	222,189 30	
New Zealand	2,101	50,705 53	16,859	408,957 90		358,252 37
Norway	65,208	1,475,796 77	3,597	91,709 66	1,384,087 11	
Peru	510	16,419 68			16,419 68	
Portugal (no business)						
Russia	2,887	38,928 42			38,928 42	
Salvador	54	1,515 01	287	1,535 18		20 17
Sweden	137,154	2,369,781 25	5,181	272,206 75	2,097,574 50	
Switzerland	36,389	717,616 29	2,681	59,684 26	657,932 03	
Union of South Africa	1,426	28,680 65	4,618	59,464 88		30,784 23
Uruguay	84	2,493 23	213	1,648 76	844 47	
Total, international basis	1,599,172	$25,854,844 56	204,411	$3,812,164 95	$22,570,162 90	$527,483 29

tralia, the Union of South Africa, Egypt and Hongkong.

2. The countries of Continental Europe — Austria, Belgium, Denmark, Germany, Greece, Hungary, Italy, Luxemburg, Netherlands, Norway, Russia, Sweden and Switzerland.

The general distinction between the two groups is that the countries named in the first (excepting the United States) rely upon an advice to facilitate and safeguard payment; those in the second use a card order sent in open mail by the issuing to the paying postmaster. In the first case, the intending remitter must file with the proper amount for order and fee a written application containing the full particulars of the remittance — amount, name and address of sender and of payee, from which the postmaster prepares the order, which is then handed to the applicant to be mailed at his own expense to the payee.

Card orders are printed on thin boards and supplied to applicants free or at a merely nominal charge. The remitter fills in the required spaces on the card and hands it with the needed sum to the postmaster. Postage stamps representing the amount of the fee are affixed to the card, which is then numbered, signed, stamped and mailed by the postmaster. No written application is required from the remitter who receives, however, for his protection, a coupon receipt corresponding to the order. (The foregoing statements refer particularly to Germany, but are believed to apply equally to the other countries named in the same class). When it reaches the office of delivery, the order is given to a letter carrier, who calls at the designated address, pays the amount to the payee and obtains the latter's signature to a form of receipt on the back of the card, which is then returned to the postmaster at the office of payment.

France uses both forms of money-order and is in a class by herself.

As a separate feature or adjunct of the money-order systems, many countries issue postal orders or notes for small sums, limiting the amount to the equivalent of $5 or $10. The notes of Great Britain and Canada are printed in fixed denominations from 6 pence to 21 shillings in the one case and from 20 cents to $10 in the other. Twenty-two separate pieces are needed to complete a set of British notes and 18 of the Canadian. Intermediate amounts may be represented by canceled postage stamps affixed to the notes.

In the French service, it is understood, fractions being excluded, the amounts are expressed in writing, from one franc to 20 francs.

In effect, card orders and postal notes are money-orders without advices, issued by the postmaster with the minimum expenditure of time and labor consistent with a reasonable degree of safety. As already explained, postal notes are for small amounts only and, as might be expected, greatly outnumber the issues of money-orders.

ALEXANDER M. DOCKERY,
Third Assistant Postmaster-General.

POSTAL SAVINGS BANKS. See BANKS AND BANKING — POSTAL SAVINGS BANKS.

POSTAL SAVINGS SYSTEM. The Postmaster-General's Annual Report for the fiscal year ending 30 June 1918 registered an increase during the 12 months of $16,516,803, at 6,678 depositories; the depositors numbering 612,188 and the total deposits amounting to $148,471,499, an average of $242.53 per depositor. Congress further amended the Postal Savings Act by increasing the amount that a depositor may have to his credit from $1,000 to $2,500, which largely accounted for the increase. The amendment also eliminated the 10-cent savings card, provided for in the original Postal Savings Act as one of the means of evidencing small deposits and stipulated that hereafter a card with 10 (instead of 9) savings stamps affixed shall be accepted as a deposit of $1, either in opening an account or in adding to an existing account or may be redeemed in cash, the card provided for by the new legislation being furnished free of charge. By eliminating the savings card as a means of evidencing deposits, the accounting made necessary by the maintenance of both the card and the stamp was reduced by one-half.

The system is self-supporting. The profit in 1918 amounted to $1,135,288.61. At the close of the year $3,963,440 of postal savings funds were invested in the postal savings bonds authorized by the Postal-Savings Act. The board also purchased for investment $14,000,000 third Liberty Loan bonds.

POSTAL UNION, The. See POST AND POSTAGE.

POSTER ART. Posters are a modern field for the artist, having been developed within the last 50 years, along with advertising art. They are usually conventional in form and any degree of exaggeration is permissible, if it attracts attention. The earliest example of the poster dates back to the days of Pompeian splendor. During the Middle Ages managers of theatres and officers recruiting for the army used pictorial advertisements. From these pictures, Jules Chèret of Paris (b. 1836), called the father of the modern poster, is said to have received his first suggestion of the possibility of adopting art to latter-day advertising. One of his first efforts was an announcement of a fairy play, ‹La Biche au Bois,› in which Sarah Bernhardt was acting in 1867. Chèret's principles were conventionality, elimination of detail, arrangement and pure color. For a long time he was almost alone in his efforts and did not attain to the pre-eminence that has come in more recent years.

In order to produce a good advertising placard it must command the attention of the public. It should be attractive to the man in the street without being vulgar; sufficiently startling, but not aggressively so. Jules Chèret understood the requisites and limitations of this kind of art better than any other of his time and his work gained for him a world-wide reputation. He can justly lay claim to founding a new school. He has defined his idea of a perfect poster as follows: «It should be as simple as possible and I consider the introduction of one figure — and need I hardly say that of a lady for choice — is indispensable; whenever it is possible this figure should be life-size. My own posters are never smaller than 60 centimeters (two feet) by 86 (nearly three feet) and my favorite size is 250 by 90; the figure should, of course, be elegantly and brightly dressed in some striking costume not likely to go out of fashion as long as the poster is to be in use. I always make a point of designing the lettering of the actual advertisements. I do not believe in black and white letters, but have no objection to their being very dark blue, red or violet; this produces the effect of lack without giving a jarring note.»

Close rivals to Chèret are Grasset and Steinlen and by some critics the two are considered to be in many respects superior to the master. Eugene Grasset, a native of Switzerland, is a decorator and architect by profession. His work is characterized by a vital principle of design, effective yet subdued. His Napoleon and Jeanne d'Arc (Bernhardt) posters are superb creations. Grasset's work is always refined and harmonious, yet less bright and striking than Chèret's. There is more repose and it appeals more to the artist than to the public. The poster of the Salon des Cent in its tenderness, its exquisite lines and its spirituality, is worthy of Rossetti.

Of the other French artists De Feure, Guillaume, Ibels, Lautrec, Boutet de Monvel, Steinlen, Willette and Jossot are perhaps the most accomplished. Bossot is a great artist, essentially a caricaturist, who works with vagabond and artistic lines and in a morbid color-scheme — rusty greens and pale yellows. Steinlen is every way a charming artist. His «Lait Pur Sterilisé,» a child in a red dress drinking from a bowl, envied by three eager tabby cats, is perhaps one of the most attractive posters ever made. Lautrec has not the refinement of Grasset, not the sprightliness of Chèret, yet he possesses an individuality which makes his work peculiarly interesting. His posters are generally simple in composition and depend to a great extent for their effectiveness on the skilful arrangement of masses. Ibels is remarkably clever in drawings that are inimitably and effectively grotesque. Aristide Bruant has done some things that are strikingly forcible in their broad masses of color. In Great Britain, Audrey Beardsley and Walter Crane were early experts in the new art. They have been worthily followed by Gordon Craig, Will Owen, Hardy, Simpson, Bell and others.

In the United States the modern poster artists include Louis J. Rhead, Will H. Bradley, Kenyon Cox, W. H. Carqueville, Edward Penfield, Ethel Reed, A. Friedler, Walter Fawcett, Max Parrish, Hy Mayer, Hamilton King, Clarence Tilt, E. Haskell, etc. The war brought forth a great demand for inspiring patriotic posters and many new men entered the ranks. By long odds the most successful of these war posters was a picture of a Red Cross nurse with a miniature wounded soldier in her arms and the inscription «The Greatest Mother in the World,» this being by A. E. Foringer.

POSTING, in Europe, traveling by means of horses hired at different stations on the line of journey. Such a system appears to have been established by private enterprise on some of the main routes in England, at least as early as the reign of Edward II. It was afterward made a government monopoly. As letters were originally forwarded in the same manner, the name of post office has come to be applied to the institution charging itself with conveyance and delivering of letters. The custom still obtains in certain parts of the world where the railway has not penetrated.

POSTMAN POET, The. See CAPERN, EDWARD.

POSTMASTERS, National Association of, an organization formed in Detroit, Mich., in 1898, taking in first and second-class postmasters and higher postal officials. They aim to improve the postal service by an exchange of information. In 1917 the president was D. T. Gerow of Jacksonville, Fla., and the secretary, W. C. Markham of Baldwin City. Kan.

POSTULANT, the canonical term for one who desires to take holy orders in the Protestant Episcopal Church of America and whose name has been entered by the bishop upon a list of postulants, as required by Canon 2, Title 1 of the Digest. A postulant may in due course be recommended, by the Standing Committee of the diocese, to the bishop for admission as a candidate for holy orders. The term is applied in the Roman Catholic Church to those on probation before entering a religious order. It is a preliminary stage for the novitiate and existed in the early days of monasticism. With modern decrees the postulant has to wait from three months to two years or more, usually in the novitiate's house.

POSTULATES, or axioms, are sets of propositions belonging to mathematical disciplines from which the remaining propositions can be deduced. Thus the axioms of Euclid constitute a tentative set of postulates for ordinary geometry. The old-fashioned view was that these axioms constitute a set of self-evident truths, referring only to one system, that of the space in which we live. The work of Bolyai, Lobachevski and Riemann, however (see GEOMETRY, NON-EUCLIDEAN), cast grave doubts on the self-evidence of these propositions, and led to the more modern attitude, according to which the axioms are merely hypotheses concerning space. As far as the mathematician makes use of the axioms it is a matter of entire indifference whether they concern space or not; in other words, strictly speaking, postulates are not propositions concerning a definite subject matter at all, but are merely forms of such propositions. Once this view is accepted it becomes easy to see that sets of postulates can be formulated for systems as unlike ordinary geometry or any ordinary mathematical system as you please, and that these sets will have just as much intrinsic, underived right to exist as that of Euclid. This has led to a large number of sets of postulates for various mathematical systems, such as non-Euclidean geometry, line geometry, analysis situs, algebra, the theory of functions of a real variable, quaternions, symbolic logic, etc. (qq.v.).

Furthermore, various sets of postulates can be formed for the same system. Thus, one can describe all the entities of geometry in terms of points and their distance-relations, or in terms of spheres and their relations of inclusion. Accordingly there are at least two possible sets of propositions characterizing the properties of geometrical entities, or, in other words, two sets of postulates for geometry. Furthermore, it is possible to define all geometrical properties in terms of the same entities by different sets of postulates. As a consequence of these facts it becomes a desideratum to determine those sets of postulates which are in some sense the most practical or simple. The criteria of simplicity usually employed are (a) the *independence* of the postulates — no set of the postulates must imply another; (b) their *fewness* in number. Independence of the postulates is demonstrated by the exhibition of systems which fail to satisfy but one of the postulates, this postulate being each in turn. E. K. Moore of Chicago discusses a strengthened form of independence, in which not only are the postulates independent of one another, but no postulate or its denial is dependent on any combination of the other postulates or their denials. Many mathematicians, however, consider this a rather unnecessary refinement. As to the fewness of the postulates, for some purposes of analysis the opposite extreme seems desirable as indicating a greater degree of analysis. However, no really unequivocal definition of the number of distinct postulates in a set has yet been given.

Besides these properties of postulates that are more or less independent of the systems they define, there are others which are bound up with the latter. In the first place, though a set of postulates always defines a class of mathematical systems, this may be the null class (see Logic, Symbolic). In that case the postulates are called *inconsistent*, otherwise they are *consistent*. The consistency of a set of postulates is demonstrated by the exhibition of a system which satisfies them. For all ordinary purposes the exhibition of a system formed from the natural numbers is regarded as sufficient. The policy of producing such a system in the case of all mathematical systems is called the *arithmetization of mathematics.*

Another desideratum of a set of postulates is that the systems they define be one from the mathematical standpoint — that is, that the set be *categorical*. A categorical set has the property that a one-one correspondence can be set up between any two systems which it defines; and that this correspondence will leave their structure invariant.

There is one set of postulates whose position in the theory is unique. This is the set of postulates for symbolic logic (q.v.). Symbolic or mathematical logic consists in the criteria and methods of logical and mathematical reasoning in all fields. It is consequently in essence an individual system, not a type of systems. Consequently, if it can be treated by the postulate method at all, its postulates are genuine individual propositions, and not propositional forms. It is by no means obvious that any finite set of postulates will suffice for symbolic logic, and the attempt of Whitehead and Russell to find such a set breaks down in certain details, yet is sufficiently close to complete success to give promise of even better results in the future.

In the course of any attempt to formulate postulates for logic, two propositions appear which are not indispensable for the development of the simpler and many of the more complicated propositions in logic and mathematics, but are continually involved in many processes of reasoning that were formerly accepted without question. There are the proposition that there are an infinite number of things in the world, and the proposition that given an aggregate A of aggregates B, some aggregate C exists containing one member of each of the B's, and only one. This latter is essentially due to Zermelo. See Assemblages, General Theory of.

There is no book devoted to postulate-theory at large, although almost any of the mathematical works of the writers already named or of Huntington, Veblen, Sheffer, Peano, Vailati or of many other writers of the last quarter century approach mathematical problems with this attitude in mind. By far the largest part of the literature is contained in the *American Journal of Mathematics*, the *Transactions of the American Mathematical Society* and the *Annals of Mathematics* for the past 15 years. For the postulates of logic consult A. N. Whitehead and B. Russell, ‹Principia Mathematica› (1910–).

Consult the various articles on mathematical disciples for their peculiar postulates, and see especially Logic, Symbolic; Assemblages, General Theory of.

Norbert Wiener.

POSTULATION, in canon law, an appeal to a competent authority to remove a disability by which one who has been appointed to a benefice is prevented from entering upon it. The term was also applied to the method by which a bishop was translated. The canon law declared that a person once elected to one see could not be elected to another; and when an electoral college desired the bishop of another see to occupy their own, they petitioned the bishop to make the change. No postulation could be made unless the electoral college were unanimous, while in the case of an election a majority was sufficient.

POT-HOLES. Cylindrical holes in rock ledges usually in or near beds of streams. They are caused by the wearing action of sand and pebbles whirled by the water. They have been called giant kettles, giant caldrons, Indian kettles, wells and the Spanish name, remolionos. Their size and character vary greatly, many of the larger ones being 10 feet in diameter and 25 feet deep. One in Saint Croix, Dallas, Wis., is 27 feet in diameter, another with diameter of 15 feet is 65 feet deep, and one 12 feet in diameter is 160 feet deep. The pot-holes of the «Glacial Gardens» of Lucerne in Switzerland are famous. In some cases, notably on Kickinghorse River, near Field, British Columbia, a small natural bridge has resulted from the coalescence of the lower parts of two or more pot-holes. The canyon at Watkins Glen, N. Y., consists partly of coalescing pot-holes. Pot-holes develop only in streams that are eroding in fairly well consolidated rock. They evolve from small hollows due to solution, removal of a lense or pebble or a joint-crack. Such hollows are necessary to hold the first few pebbles which begin the grinding. Too much sediment stops the process, but otherwise flood stages of the stream greatly facilitate the erosion. The nature and jointing of the rock and declivity and volume of the stream are important factors. Many holes, «moulins,» are of glacial origin, not caused by the ice, however, but by water falling over the edge of the ice or into holes extending to the rock floor. Irregular pot-holes or basins also occur along the coast, scoured out by tidal or other currents. Plunge pools are frequent at the foot of water falls and a notable one on the Canadian side of Niagara Falls according to J. W. Spencer is 72 feet deep. Small pits due to swirling of hard parts of sea urchins have been observed on sea coast in New Brunswick and at Biarritz, France. Consult article by E. D. Elson (in *Scientific Monthly*, Vol. V, pp. 554–567; Vol. VI, pp. 37–51, 1917–18); Gilbert, G. K., 'Bulletin, Geological Society of America' (Vol. XVII, pp. 317–370, 1906); Upham, W. (ib., Vol. XII, pp. 25–44, 1900).

NELSON H. DARTON.

POTAMIAN, pō'tā-my'ăn, **Brother** (MICHAEL FRANCIS O'REILLY), American physicist: b. County Cavan, Ireland, 29 Sept. 1847; d. New York, 20 Jan. 1917. He was educated in the public and Christian Brothers schools, New York City, London University, and the Christian Brothers Scholasticate, Montreal, Canada. In 1859 he entered the Order of the Christian Brothers; taught successively at Quebec and Saint Louis, Mo., professor at Saint Joseph's College, London, from 1870 to 1893, and professor of mathematics and experimental physics at De La Salle Normal College, Waterford, Ireland, in 1893–96, and from 1896 to 1917 professor of physics at Manhattan College, New York City. In 1893 he was appointed by the British government a member of the jury of awards at the World's Columbian Exposition, Chicago. His writings include 'Gleanings in Electrical History'; 'Franklin and De Romas, or the Lightning Kite'; 'Gilbert of Colchester'; 'The Rotation of the Earth.' He was joint author of 'Electric Illumination' (2 vols.); 'Letter of Peregrinus on the Magnet'; 'The Makers of Electricity'; 'The Makers of Astronomy'; and 'Catalogue of the Wheeler Gift' or a brief illustrated account of works on electricity and magnetism from the earliest times to the middle of the 19th century.

POTAMOGALE, the generic name of a strange West African animal (*P. velox*), which might be called the insectivorous otter. It is a true insectivore, representing the family *Potamogalidæ*, is somewhat larger than a stoat, perhaps two feet long being an average, and the appearance and habits are like those of an otter, save that it is not certain that it subsists on fish. A related smaller potamogale (*Geogale aurita*) inhabits the valleys of Madagascar.

POTASH, originally a vegetable alkali (so-called), obtained by leaching wood-ashes, evaporating and calcining, commonly called carbonate of potash or pearl-ash, K_2CO_3. Soda and potash were not distinguished by old-time chemists, but in 1807 Davy separated them. Various plants take up potash salts, and the refuse of beet-roots has been utilized as a source of potash. After the electrolytic production by Davy and others, it came to be understood that a metallic element was being dealt with and potassium (q.v.) was developed.

Commercial Potash.— Previous to the outbreak of the World War nearly the whole potash supply of the United States market was imported from Germany. A glance at the importations of 1913 shows the various forms in which the potash came in and the amounts consumed normally by the industries of the country. The figures are as follows: Kainit, 521,176 tons; manure salts, 250,529 tons; muriate of potash, 237,630 tons; sulphate of potash, 44,349 tons; argol or bitartrate of potash (mainly from France and Italy), 14,499 tons; carbonate of potash, 11,003 tons; nitrate of potash, 4,826 tons; ferrocyanide of potash, 1,706 tons; and much smaller quanties of other potash salts — cyanide, chlorate, permanganate, etc., a grand total of 1,092,588 short tons, having a content of actual potash amounting to 270,720 tons and valued at $18,073,865. Beside these, the figures of the imports of potash for 1917 indicate the remarkable change of conditions and values — 8,100 tons, valued at $7,788,406.

Although the world's supply of commercial potash had come almost wholly from mines in Germany and Austria, it was a matter of common knowledge to geologists everywhere that potash occurs very extensively in nature, being a component of granites and most other igneous rocks, and occurring in smaller amounts in the various sedimentary strata and soils. It is estimated to form 3 per cent of the earth's crust. In the dry saline matter from evaporated river waters there is generally about 2 per cent of K_2O (potassium oxide) and in the ocean from 1 to 2 per cent. Where these waters evaporate and the other saline components crystallize out, the potash accumulates in the remaining solution so that on the evaporation of the final "pan" the proportion of K_2O may be high. There are deposits of this kind in various lake basins, both recent and of various older geologic periods. Alunite, a hydrous potassium-aluminum sulphate ($K_2O.3Al_2O_3.4SO_3.6H_2O$.), contains when pure 11.4 per cent of K_2O which is made soluble by roasting.

The orthoclase feldspars which are of widespread occurrence in granite and gneiss contain from 16.8 per cent of K_2O in combination with silicic acid and some processes for separating this ingredient appear to be commercially practicable, especially when the residue can be utilized for making brick. Some of the younger igneous rocks contain much potash notably the rhyolites, trachytes and phonolites, some of which carry 8 per cent. The mineral leucite $KAlSi_2O_6$ contains a large amount of K_2O, the rock in Leucite Hills, Sweetwater County, Wyo., carrying from 9 to 11 per cent of potash. Sericite or altered mica schist in the southern Appalachians carries 10 per cent or more. Glauconite or greensand, which occurs in beds, notably in southern New Jersey, Maryland and Virginia, Kentucky, Tennessee and Georgia, contains up to 9 per cent, and in some cases 11 per cent of K_2O in form of silicate. These deposits are from five to 20 feet thick and easily worked. These various silicates are exceedingly difficult to resolve, but heat and admixture with lime and other agents liberates most of the potash.

The largest known potash deposits exist in the Permian in central Germany, the Oligocene in Alsace, the lower Miocene in Galicia, in the early Tertiary near Sauria in northeastern Spain and in beds of unknown age in India. They are associated with the great deposits of common salt, dolomite and gypsum such as occur in the Permian beds of the central United States, and it is hoped that domestic supplies may be derived from these beds. The potash deposits in central Germany have been very extensively developed by numerous mines, some of great depth. The annual production under ordinary conditions is about 7,000,000 metric tons valued at more than $30,000,000 and sold at a profit of about $4,000,000. The potash occurs in various compounds, the principal one being Kainite, $MgSO_4.KCl.3H_2O$, which is in the midst of a 3,500 foot succession of common salt and anhydrite, the products of long-continued desiccation of a water body. The potash salt was deposited at or near the end of one stage of desiccation, but there was a later incursion of waters from which finally there were deposited anhydrite and common salt. Fortunately a thin overlying sheet of clay was deposited which protected the potash from solution by the water which brought the anhydrite and salt now covering the potash.

The larger percentage of potash consumed by the world is used in commercial fertilizers, although considerable is made into chemicals for the arts and medicine and for explosives. In the latter case, however, it is not as important as it was formerly, as the high explosives do not contain it. Potash is essential to plant growth and in agriculture is rapidly depleted from the soil, and must be returned in fertilizers. It also has an important stimulating effect on soils naturally deficient in this component. The production of potash-bearing material in the United States in 1917 was 126,961 short tons, containing an average of 26.4 per cent of K_2O, an equivalent of 32,573 short tons of potash; that is, 13.6 per cent of the normal consumption of the United States. This production was three times the amount produced in 1916 and 30 times the amount in 1915. During the war the price rose from the normal rate of 50 to 75 cents a unit to about eight times as much. The average for 1917 was $4.26 per unit or a total of $13,791,922. The unit is 1 per cent K_2O per ton. The production in 1917 is shown in table below.

About 63 per cent of the total output was produced from brines in lakes, mainly from those in the Sand Hill district of western Nebraska and from Searles Lake in California. From the Nebraska lakes a total of 61,053 tons of crude potash material was marketed in 1917; equivalent to 14,588 tons of pure potash. The residue resulting from the burning of kelp, the great sea weeds on the Pacific Coast, is a potential source, but as the raw material contains 90 per cent of water the expense of handling and drying it is great. The char or clinker carries from 20 to 30 per cent of K_2O and valuable by-products, including iodine, help defray the otherwise prohibitive cost of treatment. Charred molasses residue at alcohol distilleries yields considerable potash, while waste liquor from one of the beet sugar processes is a minor source. Potash is extracted from the mineral alunite mined near Marysvale, Utah, the potassium sulphate being made soluble by calcining. Flue dust from cement mills is an important source, with constantly increasing product as mills utilize more material rich in potash and make provision to catch flue dust. The dust is leached and a high grade potassium sulphate is obtained by evaporation. In 1917 eight mills produced a total of 1,621 tons of actual potash. A very large amount of potash is given off as vapor in fumes from blast furnaces, but no provision is made to collect this material. The present small output (1917) reported from three steel companies was recovered from the dust which collected in flues and stoves. The loss of potash in the furnace gases is not less than 22 pounds for each ton of iron produced. It is believed that if the large furnaces installed suitable flues the supply would be sufficient for all domestic demands and at very low cost. A constantly increasing supply is derived from the old-fashioned source of leaching wood ashes. Considerable potash is extracted from the crude Chilian nitrate of soda. See POTASSIUM.

In 1918 production increased to 192,587 tons of products, containing 52,135 short tons of K_2O. The producing capacity of American potash plants at end of 1918, classified according to sources of raw materials, is estimated roughly as follows:

CAPACITY OF AMERICAN POTASH PLANTS.

SOURCE	Available potash (K_2O) (tons)
Natural brines:	
Nebraska lakes	50,000
Other sources	28,000
Alunite	4,000
Dust from cement mills	3,500
Kelp	5,500
Molasses distillery waste	4,000
Steffens waste water	3,000
Wood ashes	1,000
Other sources	1,000
	100,000

This quantity is about 40 per cent of our ordinary consumption in pre-war times and the output that may be maintained if the demand con-

SOURCES	Number of producers	Total production	Available potash (K_2O)	Value at point of shipment
Mineral sources:		*Short tons*	*Short tons*	
Natural brines	10	79,876	20,652	$8,219,912
Alunite (refined salts and crude and roasted alunite)	3	7,153	2,402	892,763
Dust from cement mills	8	13,582	1,621	700,523
Dust from blast furnaces	3	2,133	185	68,841
Organic sources:				
Kelp	10	11,306	3,572	2,114,815
Molasses residue from distilleries	4	8,589	2,846	1,130,907
Wood ashes	36	700	424	406,856
Evaporated Steffens water from sugar refineries	5	*2,593	359	143,430
Evaporated wool washings and miscellaneous industrial wastes	3	645	305	113,875

* Includes 1,333 tons of material produced but not sold in 1917.

tinues and the industry is not crippled by foreign competition.

Nelson H. Darton,
United States Geological Survey.

POTASH FERTILIZERS. See Fertilizers.

POTASH PRODUCTION IN THE UNITED STATES. See Fertilizers; Potash.

POTASSIUM (from "pot-ashes," wood ashes being one of the best known sources of the carbonate of the metal), a metallic element, many of whose compounds have been known from antiquity, but which was first prepared in the metallic form by Davy, in 1807, by the electrolysis of fused potassium hydrate — a substance which had previously been supposed to be itself elementary. In 1808 Gay-Lussac and Thénard showed that the hydrate can be reduced by heating it with finely divided iron and in the same year Curaudan showed that the reduction can also be effected by carbon. Several methods of preparing metallic potassium are now in use. The best known of these and the only one that was in practical service for many years consists in the direct reduction of the carbonate of potassium by carbon, the reaction being carried out in an iron retort heated to redness. The chief products of the distillation are carbon monoxide gas and metallic potassium, the latter being volatile at a red heat. The production of potassium by this method is attended by more or less danger, not only because the vapor of potassium takes fire spontaneously upon contact with air or with water, but also because under certain conditions potassium and carbon monoxide combine to form a black, explosive compound, whose production has caused a number of fatal accidents. The potassium vapor should be permitted to condense before it issues from the neck of the retort, a cooling device being provided for effecting its liquefaction, and the molten metal should then be allowed to drip into a receiver containing petroleum oil or some other similar fluid that is free from oxygen. In Castner's process, the carbonate or (hydrate) of potassium is mixed with carbon and finely divided iron, or with carbon and a metallic carbide and the reduction is effected by the agency of heat, as before. A considerable part of the commercial supply of metallic potassium is now produced, however, by the electrolysis of the melted hydrate or chloride of potassium.

Potassium is a lustrous, silvery-white metal, brittle at 32° F., but soft and wax-like at ordinary temperatures, so that it can be easily cut with a knife. It melts at about 144° F., and boils at about 1,250° F. (when heated in an atmosphere of hydrogen), its vapor being green. It has a specific gravity of about 0.87 and, with the exception of lithium, is the lightest metal known. Its specific heat is 0.166 and its coefficient of linear expansion (Fahrenheit scale) is about 0.0000467. It conducts electricity much better than mercury does and it is soluble in anhydrous liquid ammonia (NH_3), forming a blue solution from which metallic potassium is again deposited upon the evaporation of the ammonia.

Chemically, potassium has the symbol K (from *kalium*, Latin for potash), and the atomic weight 39.15. It oxidizes in the air with great readiness, a freshly cut surface becoming almost instantly covered with a film of oxide. It also decomposes water vigorously, uniting with it to form potassium hydrate, KOH, in accordance with the equation

$$K + H_2O = KOH + H,$$

hydrogen gas being liberated at the same time. When potassium is thrown upon the surface of water it floats and the heat generated by the chemical action is sufficient to set fire to the liberated hydrogen and to part of the potassium. This experiment is a favorite one in the lecture room, since it is beautiful as well as instructive, the flame having the purple color that is used in the laboratory as a test for the presence of volatile potassium salts. (See Blowpipe Analysis). Potassium never occurs in nature in the free state, but it forms an essential constituent of many minerals, among the most important of which are feldspar, nitre and carnallite. Chloride and sulphate of potassium are found in sea water and various springs. It also occurs in the animal body and in plants and in remote country districts its carbonate is still prepared (chiefly for the manufacture of soap) by leaching wood ashes. (See Potash). Wool yields an organic potassium salt, which may be washed out from the natural grease or suint.

Troast and Heutefeuille's experiments show that when potassium is heated to over 200° C. it occludes hydrogen gas. In a vacuum, when diluted with hydrogen, the compound will lose hydrogen above 200° C., down to a certain point.

The potassium compounds are exceedingly numerous and many of them are of great importance both in the laboratory and in the arts. Two oxides of the metal are certainly known and others probably exist also. Potassium monoxide, K_2O, which is the oxide that is understood when "potassium oxide" is mentioned without qualification, is formed when thin slices of the metal are allowed to oxidize in cool, dry air. It may be prepared more readily on the large scale by heating potassium just to its melting point and then leading over it a stream of air that has been dried and freed from carbon dioxide. The monoxide is a gray, brittle substance, which has a specific gravity of 2.66 and melts at a strong red heat. It has a powerful affinity for water, with which it combines with the evolution of much heat, to form potassium hydrate, KOH. Potassium tetroxide (or peroxide) is formed when potassium is burned in a stream of pure, dry oxygen. It has the formula K_2O_4, and is a yellowish substance at ordinary temperatures, melting, at a red heat, to a black liquid, which crystallizes upon cooling. The tetroxide combines with water to form potassium hydrate and peroxide of hydrogen, oxygen being also set free at the same time. When heated to a white heat, the peroxide gives off oxygen and becomes reduced to the monoxid.

Potassium chloride, KCl, occurs native in large quantities at Stassfurt, Germany, chiefly in combination with magnesium chloride, with which it forms the mineral "carnallite," $KCl.MgCl_2 + 6H_2O$. Most of the commercial supply of potassium chloride is now prepared from this mineral by crystallizing its solution. In order to obtain a satisfactory product, however, many practical details must be carefully attended to, for which reference must be made to advanced works on inorganic chemistry and to treatises on alkali manufacture. Potassium chloride is very similar in its general properties to sodium chloride (common salt). It has a saline taste, is white in color and crystallizes in cubes. Its specific gravity is 1.94 and it melts at about 1,350° F. Potassium chloride is now extensively used as a source of potassium in the preparation of other salts of that metal.

Potassium nitrate or «nitre» (q.v.), KNO_3, occurs native, but the greater part of the commercial supply is now manufactured by acting upon the cheaper nitrate of sodium ($NaNO_3$) by means of potassium chloride; the reaction being as indicated by the equation

$$NaNO_3 + KCl = KNO_3 + NaCl.$$

Potassium forms two carbonates, known respectively as the «normal» carbonate and the «acid» carbonate. Normal potassium carbonate, K_2CO_3, may be obtained in an impure state by leaching wood ashes and evaporating the resulting solution to dryness. The residue is then strongly heated to destroy any organic matter that it may contain and is subsequently redissolved and redeposited by evaporation. The crude product as obtained from wood ashes is known as «pearl-ash» or often simply as «potash.» Pure normal potassium carbonate is best prepared by heating ordinary monotartrate of potassium (see below), which is thereby resolved into a mixture of free carbon and potassium carbonate, from which the latter salt may be obtained by solution, filtration and subsequent evaporation. Acid potassium carbonate has the formula $HKCO_3$, and may be prepared by passing carbon dioxide over the normal carbonate or through its concentrated solution in water; the reaction being as indicated by the equation

$$K_2CO_3 + CO_2 + H_2O = 2HKCO_3.$$

The greater part of the commercial supply of normal potassium carbonate is now prepared by a method similar to the Leblanc process for the preparation of carbonate of sodium. (See SODIUM). Normal carbonate of potassium is quite strongly alkaline and is deliquescent and very readily soluble in water. It is used in the manufacture of soap and as a raw material in the manufacture of various compounds of potassium. The acid carbonate is much less soluble than the normal salt and its solution is nearly neutral to litmus paper.

Potassium hydrate, potassium hydroxide or «caustic potash,» KOH, is formed when metallic potassium is dissolved in water; but the commercial supply is obtained either by the electrolysis of a solution of a potassium salt or by acting upon a solution of normal potassium carbonate by means of slaked lime, $Ca(OH)_2$; the reaction, in the latter case, being as represented by the equation

$$K_2CO_3 + Ca(OH)_2 = 2KOH + CaCO_3.$$

The calcium carbonate ($CaCO_3$) that is formed at the same time is practically insoluble and may be removed by filtration. The solution is then evaporated to dryness and the resulting hydrate of potassium is finally melted and cast into sticks in metallic molds. Potassium hydrate is a white substance, absorbing moisture from the air with great readiness and also taking up carbon dioxide gas from the air, being thereby converted into the acid carbonate. The hydrate dissolves in half its own weight of water, the solution being intensely alkaline. The solid hydrate has powerful cauterizing properties (whence the name «caustic potash») and destroys the skin when brought in contact with it. It is used in the arts and in the laboratory for a great variety of purposes.

The bromide of potassium (KBr) and the iodide (KI) are soluble, crystallizable salts, which are largely used in medicine and in photography. The bromide may be prepared by adding bromide to a solution of potassium hydrate, the reaction being

$$6KOH + 6Br = 5KBr + KBrO_3 + 3H_2O.$$

To remove the potassium bromate ($KBrO_3$) that is formed, the solution is evaporated to dryness after the addition of a small quantity of powdered charcoal and the dry residue is well pulverized and finally raised to a dull red heat. The carbon that is present then reduces the bromate to potassium bromide and free carbon dioxide gas. When this process is complete, the mass is cooled and redissolved in water, after which the pure bromide of potassium is prepared by evaporation and crystallization. Iodide of potassium may be obtained in a similar manner. Potassium chlorate, $KClO_3$, which is used in the laboratory for effecting oxidations and also as a source of free oxygen and which is likewise employed in medicine, may be prepared by passing chlorine gas through a warm, concentrated solution of potassium hydrate; chloride of potassium being formed at the same time, as is indicated by the equation

$$6KOH + 6Cl = 5KCl + KClO_3 + 3H_2O,$$

the reaction being entirely analogous to that given above for the formation of potassium bromide. As will be seen from the last equation, only one-sixth of the potassium of the original hydrate is converted, by this method, into the form of chlorate; the remaining five-sixths being converted into the chloride. The process as given is, therefore, wasteful; for, although the potassium chloride may be easily recovered, it is not available for the manufacture of further quantities of the chlorate until it has been reconverted into the hydrate. In practice it is, therefore, customary to prepare calcium chlorate, $Ca(ClO_3)_2$ as the first step in the process; potassium chlorate being then obtained by treating the calcium chlorate with potassium chloride, according to the equation

$$Ca(ClO_3)_2 + 2KCl = 2KClO_3 + CaCl_2.$$

Several sulphates of potassium are known, the most important of these being the normal sulphate, K_2SO_4, and the acid sulphate, $HKSO_4$. These may be prepared by the action of sulphuric acid upon potassium chloride; but the commercial supply is obtained in large measure from the mineral «kainite,» which occurs in great quantities at Stassfurt and which consists of normal potassium sulphate in combination with the sulphate and chloride of magnesium. It is also obtained as a by-product in the working up of beet root, vinasse and kelp, and in other chemical industries. Normal potassium sulphate forms, with aluminum sulphate, a compound familiarly known as «alum» (q.v.) or «potash alum,» which crystallizes in octahedra having the composition

$$Al_2(SO_4)_3 + K_2SO_4 + 24H_2O.$$

Three important salts of potassium, known respectively as the cyanide, ferrocyanide and ferricyanide, are described under HYDROCYANIC ACID, and the permanganate of potassium is described under MANGANESE. Several sulphides of potassium may be prepared, the best known being those having the formulæ K_2S, K_2S_2, K_2S_3, and K_2S_5. These are all soluble and evolve sulphuretted hydrogen when heated with an acid. Common «liver of sulphur» is a brown, ill-smelling substance, prepared by heating normal potassium carbonate with sulphur. It contains various sulphides of potassium, together with more or less of the normal sulphate and carbonate of potassium. When potash and pulverized quartz are melted together, a compound of potassium, oxygen and silicon is obtained, which is usually described as a silicate of potassium. This compound is soluble in water and is known in the arts as «potash water glass,» the corresponding compound of sodium being known as «soda water glass.» The residue left when a solution of water glass is evaporated has a glassy appearance, from which fact the popular name is derived.

With tartaric acid, $H_6C_4O_6$, potassium forms two compounds (the acid being dibasic) Monopotassium tartrate, or acid potassium tartrate, $KH_5C_4O_6$, is formed in the course of the fermentation of wine, and, as deposited by the wine in a crude state, is known as «tartar,» or «argol.» When purified, it constitutes the substance familiarly known as «cream of tartar,» which is used in the manufacture of various baking powders. The normal tartrate of potassium, $K_2H_4C_4O_6$, is not used in the arts to any great extent.

With the fatty acids (for example, stearic, palmitic, etc.), potassium combines to form salts that are familiarly known as «soaps»; the combination being usually effected by boiling potassium hydrate or carbonate with fat. The fats are composed of glycerine in combination with various fatty acids; and the potassium, being more basic than the glycerine, replaces it in the compound, the result being the formation of a soap, and the simultaneous liberation of free glycerine. See SOAP.

Sources of Potassium.— Since the largest deposits of potash salts are in Prussia, the United States experienced a scarcity as the war progressed; in fact there had been a shortage of supply in America and friction over the importation as early as 1909. The year before the war our importation of potassium salts from Germany was about 525,000 tons. When this was cut off we had to get along with less than a tenth of the usual supply, and potash as a fertilizer had to be foregone, as the price was prohibitive. These conditions caused active search for new sources of supply. Wood ashes were carefully saved for leaching. The Bureau of Soils, Department of Agriculture, obtained an appropriation for experiments as to the best methods of securing potassium in commercial quantities, and the United States Geological Survey also expended considerable time and money in searching for deposits. Small quantities were found in Arizona, Colorado and Nevada, but it was not until a large deposit was uncovered in Utah in 1915 that this source of supply assumed importance. In 1916 the Survey classified 24,656 acres of Indian lands as potash land and prospecting commenced. One of the most promising finds was Searles Lake, California, a dried-up salt lake with an area of 7,500 acres and a crust 50 to 100 feet deep, saturated with a brine rich in ash and borax. The salt lakes of Nebraska also yield a supply. Potash feldspar and silicate of potash have been located at a number of places, and only await practicable methods of extraction to become available; while a considerable group of inventors are striving to improve and cheapen methods of extraction. Investigation of the dust and waste of the blast furnaces has disclosed a source that should be conserved. The dust that gathers around the bases of hot-blast stoves in such quantities is now carefully saved and utilized. Cement mills also yield a dust rich in potash, which is being gathered more or less, and the distillery wastes have contributed a little more. The 1915 production of potash salts in the United States was 9,720 tons; for 1917 about 32,000 tons and for 1918 the estimate is 40,000 tons, which is only one-eighth of the normal consumption.

The prospective supply of potash within the United States is summarized by the Geological Survey as follows: The 7,000 to 8,000 acres of Searles Lake, California, are estimated to contain about 20,000,000 tons of actual potash, enough to supply the present demands of the country for 80 years. About 100,000 tons annually may be recovered from the dust of cement mills. Approximately 380,000 tons of potash are annually volatilized in the blast furnaces of the United States, and much of this could be recovered by installing proper apparatus, not unduly expensive. The numberless salt lakes of Nebraska, chiefly in the Sand Hill region, range from an acre to a square mile in area, with a crust varying from a few inches to three feet in thickness. It has been discovered that below the hard pan bottom of these lakes is a layer of sand saturated with a strong potash brine, resting on a second bottom of hard pan. The possibilities of this source have not been estimated, but they are large. At the Salduro salt marsh, in Utah, wells have been sunk, and the brine pumped from them is found to be closely similar to the artificial brines of the German potash works at Stassfurt. The dumps of old copper and gold mines now being reground for treatment by the flotation process are found to contain considerable amounts of potash easily recoverable. The present possibilities of the molasses distilleries is estimated at 30,600 tons per annum; and from the beet sugar works it is expected to get 16,000 tons of pure potash a year. The supply from kelp is not regarded as especially promising. The difficulty of drying the raw material before it can be calcined, and the tendency of the great kelp plantations to become diseased and disappear entirely from a given locality renders the kelp-potash industry hazardous. The green sands of New Jersey are estimated to contain not less than 2,000,000,000 tons of actual potash.

The costs of getting potash from these various sources is estimated as follows: From the brines of the Nebraska lakes, $120 per ton; from roasting alunite (as at Marysvale, Utah), $40 per ton; from cement mill dust (as at Hagerstown, Md.), $30 per ton; from the German mines at Stassfurt, $40 per ton. The German product was sold in the American market at (about) $80 per ton and the investment in the German mines is about $150 per ton of annual product. This is not much less than the investment at the Hagerstown cement mills, where the net cost per ton is $10 less than at the German mines. The market price of actual potash in the United States in 1917 averaged about $423.50 per ton. See also Potash, Commercial.

Potassium in Medicine.— Caustic potash is a useful irritant and caustic and may be used to kill off warts and other morbid growths. Permanganate of potash is valued as an antiseptic and disinfectant. Where an old sore tends to gangrene it may be applied wet to oxidize the products of decomposition. A 1 per cent solution has been recommended for external use on snake-bites. Any potassium salts taken internally serve as cardiac depressants, and also reduce the nervous action. Very small quantities of potassium are administered by the medical profession, in a variety of forms, internally, for several ailments; but it should be taken only under a physician's advice, for it is properly classed as a poison. An overdose causes abdominal pain, burning, diarrhœa and vomiting and should be treated with emetics, followed by lemon juice, then vegetable oil and white of egg. Washing out the stomach is of course advisable. Nitre paper, made with potassium nitrate, is burned by asthmatic patients, that they may inhale the fumes and relieve the paroxysms. Acetate and citrate of potassium are sometimes employed to increase the flow of urine. Potassium salts will neutralize the gastric acid, and small doses may thus relieve an acid condition of the digestive tract, but the tendency to induce inflammation and gastritis should not be overlooked.

Consult Bulletins of the United States Geological Survey; also Bulletins, United States Department of Agriculture, and Cushman and Coggeshall (in 'Eighth Inter-Congress of Applied Chemistry,' Vol. V, 1912).

POTASSIUM PERCHLORATE. See Perchloric Acid.

POTATO, a perennial herb (*Solanum tuberosum*) of the family *Solanaceæ*. It is a native of the Chilean and Peruvian Andes. Its tuberous roots send up weak stems which bear pinnate leaves and white or lilac flowers which in cultivation are rarely followed by fruits. When fruits are produced they are globular, yellow or purple, and about the size of a gooseberry. The plant is extensively cultivated in temperate climates for its tubers, which are used as a staple food for man, and to a less extent for animals. It was in cultivation before the discovery of America, and was taken to Europe (probably to Spain from Peru) in the early part of the 16th century. It seems that Sir Francis Drake introduced it into England in 1586, though Sir Walter Raleigh is said to have brought it with him the year previous. Gerarde mentions it in his *Herball* in 1597 under the name *Batatas Virginiana,* but it seems to have been regarded somewhat as a curiosity until the latter part of the 18th century, although the Royal Society of London had recommended it in 1663 as a possible safeguard against famine among the Irish peasantry. Owing to the failure of grain crops in 1772 the potato soon commenced to grow in popularity as a food-plant, but even as late as 1771 only two varieties, one white and one red, were listed. In 1900 it was no uncommon thing for agricultural experiment stations in the United States and Europe to test more than 150 varieties at one time. The crop is one of the most important in Germany, France, Ireland and the United States. In the last-named country the yield per acre averages less than 100 bushels (1917), but with proper attention to cultivation, etc., yields of 200 to 400 bushels are not unusual, and even 1,000 bushels have been obtained under the best conditions. By artificial methods 2,558 pounds of tubers have been grown from one pound of seed in one season; but this was in a competition for prizes. The crop in the United States for 1917 was 442,536,000 bushels. Besides being an important article of food the potato is largely used in the manufacture of starch, and in some countries for making alcohol, etc. For such purposes special varieties are generally grown; these are usually coarse and are little used for human food.

The culinary varieties have been found to contain about 78 per cent water, 18 per cent starch, 2.2 per cent protein, 1 per cent ash and 0.1 per cent fat. During storage these proportions change, since the tubers shrink nearly two per cent a month as an average for seven months. Since the potato is rich in starch and poor in protein it is valued chiefly as a carbohydrate food, the deficiency of protein being made up by eggs, meat, fish, beans, peas, etc., and that of fat being supplied by butter, fat, oat-meal, etc. During the process of cooking the cells are ruptured, the starch expanded and made «mealy,» and great changes in flavor and palatability are produced, either by the dissipation of raw flavors, the development of new ones, or both. In the cooked state more than 90 per cent of the nutritive substances are considered assimilable. Large quantities of potatoes are annually evaporated to supply the demand for provisioning expeditions, camps, cruises, etc. «Saratoga chips» are thin slices of potato which have been fried in fats or oils and sprinkled with salt. The potato is cooked in perhaps a greater variety of ways than any other vegetable, but fundamentally the various processes are baking, boiling and frying, the first being the most economical when properly performed.

Methods of Propagation.— The potato is propagated almost wholly by means of its tubers, which are cut in many ways intended to increase the amount of «seed.» Some growers plant the whole tuber, others half-tubers, and others «single-eye pieces.» Probably there is no one method which is best under all conditions of soil, cultivation, etc., but it seems as if the half-tuber of medium-sized, well-formed specimens is in most general favor. Extra large and little potatoes are not favored. In the propagation of new varieties seed-balls are used, and after the variety is proved to be worthy it may be increased rapidly by means of cuttings made from the sprouts. These are rooted under glass in the same way as geranium cuttings, etc., and the rooted plants set in good soil when the weather has become settled. Some growers expose their «seed potatoes» to the sun for about 10 days before planting in order to hasten the growth. During this period of exposure small rosettes of sprouts appear at the eyes, and it is claimed that some of the starch is converted into sugar, with the result that when the tubers are planted they make a more rapid growth than under ordinary conditions. With certain varieties and upon certain soils the period of growth may be shortened to eight weeks or even less.

The plants will thrive in the cooler tropics and even in the colder temperate regions; in moist and dry climates; and on many kinds of soil. But the mild-temperate regions, fairly dry climates and light loamy soils generally suit them best. Such produce earlier, mealier, more highly flavored potatoes than the other conditions. While Americans demand potatoes of this order, Europeans seem generally to prefer the harder, less mealy tubers, produced in cloudy climates and upon rather rich, moist loamy soils. The soil should be well supplied with organic matter, but this should not be added fresh in the form of stable manure. Such applications should be made to a previous crop, such as corn, since practice has shown that the quality of the crop is thus improved. Generous applications of commercial fertilizers should be given. Dried blood, sulphate of potash, superphosphate, ammonium sulphate and wood ashes are favorite fertilizers for this crop. The amounts to apply will depend largely upon the character and quality of the soil. The plowing should be as deep as the surface soil will permit, six inches or more. It should be done as soon as the weather becomes settled. The «seed» is dropped at intervals of 12 to 18 inches in rows about 30 inches apart. Generally this is done by hand in a furrow about four inches deep, but upon a large scale potato planting machines are used. These machines make their own furrows, sow the fertilizer, drop the «seed» at regular intervals, cover the row and mark the position of the next row.

Before the young plants appear a weeder is run over the field once or perhaps twice to keep the surface loose and to destroy spouting weeds; after the plants are up the cultivator is used between the rows until the vines cover and shade the ground. Flat cultivation is in general vogue, but ridging or hilling has its advocates, who claim that the practice dries and warms the soil, thus hastening maturity, and that the young potatoes are less likely to be exposed to the sun and thus become green. When the tops begin to turn yellow the tubers may be dug; but late kinds, which are generally planted three or four weeks later than the earliest crops and about two inches deeper, are allowed to remain in the ground until the vines have died or until the weather becomes cold in the autumn. The number of cultivations varies from a minimum of three for the earliest crops, to a maximum of eight or sometimes more for the late. Hand digging is usually practised upon small farms; a specially made plow is also often employed; but upon large plantations machines which sift the tubers from the soil and leave them at the surface are in common use. In the South a second crop of potatoes often follows the first in the same season; in the North the land occupied by early potatoes is often planted to winter wheat; that occupied by a late crop is left bare until spring when cereals frequently are sown. Potatoes are favorite crops for preparing the land for such crops as strawberries, raspberries and other small fruits, truck crops, etc.

Insects.— Among the insects which feed upon the potato are tortoise blister and flea beetles. The three-lined potato beetle (*Lema trilineata*) and the tomato worm (*Sphinx quinque-maculata*) are also frequently seriously troublesome. The most widely destructive enemy, however, is probably the potato-bug or properly the Colorado potato beetle (*Doryphora decemlineata*). Unlike most insect pests this beetle became troublesome first in the West and migrated eastward. When the potato was first cultivated in the West this insect left its original food plant the sand-bur (*Solanum rostratum*), and traveled from field to field, living upon potato vines. In 1860 it had become troublesome in Nebraska; in 1870 it was busy in Ohio and Ontario; and in 1875 it was well known in the Atlantic States as far south as Virginia. Its spread in the South has been less rapid probably because the potato is there less extensively grown than in the North. The hibernating adults appear in the spring and lay yellow eggs in clusters upon the foliage, sometimes even before it appears above the surface. In about a week the red larvæ appear, eat ravenously for about three weeks, pupate for about 10 days and emerge for feeding and egg-laying. From two to five broods appear in a season. This insect has a number of enemies, but farmers prefer to depend upon Paris green or other arsenites which are sometimes applied as a dust while the dew is on the plants, but usually as a spray. This is also more or less effective for the other species mentioned above.

Two stalk-borers are often troublesome; one, the larva of an owlet moth (*Gortyna nitela*), the other of a beetle (*Trichobaris trinotatus*). Wilting of the vines is generally the first indication of their presence and the only remedy recommended is the burning of the vines as soon as observed to be wilting.

Two so-called plant diseases are reported troublesome in the North; early blight (*Alternaria solani*) and late blight or rot (*Phytophthora infestans*). In the South *Bacillus solanacearum* is believed to be the cause of the brown rot. These three maladies are characterized by the destruction of the plants and are thought to be spread by insects which feed upon the foliage. Hence the remedies most in vogue are the control of the insects and the use of Bordeaux mixture, Paris green, and Pyrox. Care in selecting «seed» potatoes from non-infected districts and rotation of crops, the potatoes being moved to fresh soil each year, are also recommended. The scabbiness of tubers is thought to be prevented by soaking the «seed» in a solution of formalin or of corrosive sublimate, and by rotation of crops.

Consult Gilbert, A. W., 'The Potato' (New York 1915); Grubb, E. H., and Guilford, W. S., 'The Potato' (ib. 1912); Riley, C. V., 'Potato Pests' (ib. 1876); Smith, J. B., 'Economic entomology' (Philadelphia 1896); also bulletins of the United States Department of Agriculture and of the State Agricultural Colleges.

POTAWATAMI. See POTTAWATTOMI.

POTEMKIN, pŏ-tĕm'kin (Russ. pŏt-yŏm'-kin), **Gregory Alexandrovich,** prince of Taurida, Russian field-marshal: b. Smolensk, Russia, 1739; d. Bessarabia, Russia, 16 Oct. 1791.

He came of a noble Polish family, entered the Russian army, was distinguished for bravery in the war against the Turks in 1771–72 and was promoted lieutenant-general. He soon supplanted the brothers Orloff in the favor of the empress Catharine and for years was her acknowledged lover. When she found another more to her taste, choosing Zavadovsky as prime favorite, Potempkin was clever enough to retain his political supremacy with her, and she continued to rely on his advice, which permitted him to wield great power. He enlarged the Russian army, built a fleet on the Baltic Sea, annexed the Crimea, founded the cities Kherson, Kertch, Nikolaiev, Sebastopol, etc., was honored by Frederick the Great, Maria Theresa, Joseph II and other monarchs, and became recognized as an important factor in the politics of Europe. He was waging a successful war against Turkey at the time of his death. In his private life he was mean and avaricious, though loaded with wealth by the empress, and his public life, though eminently successful, shows little indication of high ability as a statesman. Consult Cérenville, 'Vie de Prince Potemkin' (1807).

POTENTIAL. In the third volume of the 'Mécanique Céleste,' Laplace, in 1784, determined the attraction exerted by a spheroid on a particle outside the mass, in the course of which he discovered the so-called potential function as the limit of the sum obtained by dividing every element of the mass of the attracting body by its distance from the point upon which the force is exerted. That is, in the case of gravitation, if Δm denotes the element of mass, r the distance from the particle at P and V the potential function, then

$$(1)\quad V = \underset{\Delta m = 0}{\text{limit}}\ \Sigma \frac{\Delta m}{r}.$$

where the numeration includes all the elements that compose the mass M. Laplace then proceeded to show that if the potential function of a mass was known at any external point, the attraction exerted in any direction by the mass upon that point could be found at once by performing a differentiation of the function in the required direction and, finally, that such a potential function would always be a solution of the differential equation

$$(2)\quad \nabla^2 V \equiv \frac{\delta^2 v}{\delta x^2} + \frac{\delta^2 v}{\delta y^2} + \frac{\delta^2 v}{\delta z^2} = 0$$

when ∇^2 is a symbol generally employed to denote the operator

$$\nabla^2 \equiv \frac{\delta^2}{\delta x^2} + \frac{\delta^2}{\delta y^2} + \frac{\delta^2}{\delta z^2}.$$

This is called Laplace's equation and V is a potential function.

Poisson (1813), a student of Laplace, gave the form of the equation which V must satisfy for all points, situated either within or without the attracting mass, as

$$\nabla^2 V = -4\pi\rho.$$

This equation must be satisfied by the potential function for every conceivable distribution of attracting matter at any point P, where ρ is the density of the attracting matter at P. Since $\rho = 0$ for points outside, Poisson's equation reduces to that of Laplace in such a case.

In 1827, George Green, a self-educated mathematician, before he took his degree at Cambridge in 1837, noted the peculiar property of V; namely, that it is a function of the initial and the final position only, thereby recognizing its universal application in dynamics in the treatment of a conservative system of forces, that is, a system that is independent of all intermediate conditions. For example, the work done in moving a mass against the force of gravity from P to Q is the same whether it is lifted directly up from P to Q or moved along any other path, as an inclined plane, provided always there is no friction. That is the earth, and every mass connected therewith constitutes a conservative system with respect to gravity. The work done is independent of the path. But if, as in practice, friction is involved, some energy is dissipated in overcoming this force and the system is no longer conservative. Green recognized, therefore, that, so far as natural phenomena are concerned, forces that are functions of distances only constitute a conservative system to which the theory of the potential is applicable and, in particular, that in addition to gravitation, forces exerted by electrified and magnetized bodies upon each other are of this nature. Green was the first to call V the potential function. Its peculiar property may be said to be this: that it measures the work done in moving a unit of mass, electricity or magnetism from one position to another by virtue of the forces in action.

Attraction.— Newton's law states that every particle of a body attracts every particle of another body with a force that varies directly as the product of the masses of the attracting particles and inversely as the square of the distance between them. Let P be any particle, or point, M any mass, ρ the average density of an element of mass, Δv, Q a point of the element whose co-ordinates are x', y', z' and take x, y, z as the coördinates of P. By definition the attraction at P in the direction PQ will be $\frac{\rho\Delta v}{PQ^2}$ and its components in the direction of the axes become $\frac{\rho\Delta v}{PQ^2}\cos\alpha$, $\frac{\rho\Delta v}{PQ^2}\cos\beta$, $\frac{\rho\Delta v}{PQ^2}\cos\gamma$, where α, β, γ are the direction cosines of PQ. But $QP^2 = r^2 = (x'-x)^2 + (y'-y)^2 + (z'-z)^2$, whence $\cos\alpha = \frac{x'-x}{r}$, $\cos\beta = \frac{y'-y}{r}$, $\cos\gamma = \frac{z'-z}{r}$. Denoting the components of the total attraction by X, Y, Z, we have, by Newton's law:

$$X = \iiint \frac{\rho(x'-x)\,dx'\,dy'\,dz'}{r^3},$$

$$Y = \iiint \frac{\rho(y'-y)\,dx'\,dy'\,dz'}{r^3},$$

$$Z = \iiint \frac{\rho(z'-z)\,dx'\,dy'\,dz'}{r^3},$$

when the integration is taken over the mass M. It follows that the resultant attraction at P due to M will be $R = \sqrt{X^2 + Y^2 + Z^2}$. But by definition, the potential function of P due to M, assuming as the element of mass

$dm = \rho dx'dy'dz'$ will be

$$V = \int\int\int \frac{\rho dx' dy' dz'}{r^{\frac{1}{2}}} = f(x, y, z), \text{ and } \frac{\delta v}{\delta x} =$$

$$\int\int\int \frac{\delta}{dx} \left\{ \frac{\rho dx' \, dy' \, dz'}{[(x'-x)^2 + (y'-y)^2 + (z'-z)^2]^{\frac{1}{2}}} \right. =$$

$$\int\int\int \frac{\rho(x'-x)dx'dy' \, dz'}{r^3},$$

differentiation under the sign of integration being possible when P is outside the mass M, since *r*, the radical in the denominator, can in that case never become infinite. By comparison observe that the last expression is the attraction X. That is

$$\frac{\delta v}{\delta x} = Y, \frac{\delta v}{\delta y} = X, \frac{\delta v}{\delta z} = Z; \text{ whence}$$

$$R = \sqrt{X^2+Y^2+Z^2} = \sqrt{\left(\frac{\delta v}{\delta x}\right)^2 + \left(\frac{\delta v}{\delta y}\right)^2 + \left(\frac{\delta v}{\delta z}\right)^2}.$$

That is, to find the component of the attraction in any direction for a point P, find the potential function at P and differentiate this function partially in the required direction.

Potential Function as Measure of Work.— By definition, the work done in moving a unit of mass along a path S against a force F is equal to the product F × S. Let the attraction at any point of the path and opposing the force F be $-\frac{\delta v}{\delta s}$, negative since in the opposite direction from the motion, and let Δs be an element of the path. Then, if the unit mass moves from P_1 to P_2, the work done is given by

$$W = \underset{\Delta s = 0}{\text{limit}} \sum_{P_1}^{P_2} F\Delta s = -\int_{P_1}^{P_2} \frac{\delta v}{\delta s} \, ds = V_1 - V_2,$$

when V_1 and V_2 are the values of the potential function of P_1 and P_2 respectively. That is, the difference or loss in potential measures the work done.

Since the difference of potential is the measure, we observe that the farther P_2 is from the attracting mass the less V_2 becomes. For, in general,

$$V = \underset{\Delta m = 0}{\text{limit}} \Sigma \frac{\Delta m}{r_{\mu}},$$

and if r_0 denotes the distance of the nearest point in the attracting mass from P, then

$$V < \frac{1}{r_0} \Sigma \Delta \, m, \text{ or } V < \frac{M}{r_0}.$$

That is, when P is at infinity $r_0 = \infty$, and the potential is zero.

It follows that when P_2 is at infinity,

$$W = V_1 - V_2 = V_1.$$

That is, the potential function or the potential at any point P, due to an attracting system, is equal to the work done in moving a unit mass considered as concentrated at P, from P to infinity along any path. In most modern works on mathematical physics the word «potential» does not denote the value of the potential function at a point but measures the work done in moving a mass from a given position to infinity in the presence of the system considered. W is used by some authors as «the potential of the mass M' with reference to the mass M.» Others use the negative of W as the equivalent of «the mutual potential energy of M and M'.»

Laplace's Equation.— It is not difficult to show that $\frac{\delta V}{\delta x}, \frac{\delta V}{\delta y}, \frac{\delta V}{\delta z}$ are everywhere finite and that, as a consequence, the potential function is always finite and continuous. Moreover, when P is outside ψ the masses, the expression under the radical in $\frac{\delta V}{\delta x}$ is everywhere finite within the limits of integration and it becomes possible to differentiate under the signs of integration. That is,

$$\frac{\delta^2 V}{\delta x^2} = \int\int\int \frac{3(x'-x)^2 - r^2}{r^5} dx' \, dy' \, dz',$$

$$\frac{\delta^2 V}{\delta y^2} = \int\int\int \frac{3(y'-y)^2 - r^2}{r^5} dx' \, dy' \, dz',$$

$$\frac{\delta^2 V}{\delta z^2} = \int\int\int \frac{3(z'-z)^2 - r^2}{r^5} dx' \, dy' \, dz',$$

whence we derive by addition Laplace's equation as one to be satisfied by the potential function at all points outside the attracting mass

$$\nabla^2 V = \frac{\delta^2 V}{\delta x^2} + \frac{\delta^2 V}{\delta y^2} + \frac{\delta^2 V}{\delta z^2} = 0.$$

The generalized form due to Poisson requires an application of a form of Green's theorem due to Gauss and is applicable to all points. As stated, Poisson's equation is $\nabla^2 V = -4\pi\rho$.

For a clear treatment of the elements of the theory of the potential function, consult 'Newtonian Potential Function,' B. O. Peirce, 1886, from which the present article is in the main derived. Consult also the mathematical papers of George Green, reprinted by Ferrers; Thomson and Tait, 'A Treatise on Natural Philosophy'; Maxwell, 'An Elementary Treatise on Electricity'; Watson and Burbury, 'The Mathematical Theory of Electricity and Magnetism'; Clausius, 'Die Potentialfunktion und das Potential.'

J. Brace Chittenden, Ph.D

POTENTILLA, CINQUEFOIL, or FIVE-FINGER, a genus of herbs and shrubs of the order *Rosaceæ*. The numerous species are mostly perennials and widely distributed in the north temperate and Arctic zones. They have compound leaves and variously colored flowers like the strawberry, from which the species are readily distinguished by the dry receptacle: that of the strawberry is juicy. They blossom throughout the whole season with a climax in midsummer. They may be readily propagated by division and by seed, and thrive well upon heavy soil. However, they may become persistent weeds in favorable situations. *P. fruticosa* is especially troublesome upon moist soils when it has once become established. *P. tridentata* is an evergreen species which forms a dense carpet of verdure.

POTENZA, pō-tĕn'zä, Italy, a river, province and city. (1) The Potenza River lies in northern Italy in the province of Macerata, rising in Monte Pennino, about 4,800 feet above sea-level, crosses the province in a northeasterly direction, and empties into the Adriatic at Porto Recanati, near Potenza Picena, the ancient Roman colony of Potentia, founded 184 B.C., the site of the abbey of Santa Maria. (2) The province lies 200 miles south of the river, and was formerly called Basilicata, being described under that name; it has about 500,000 inhabitants. (3) The city, capital of the province, lies on the left bank of the Basento and on the railroad between Naples and Metaponto, is the seat of a bishop and of several important courts, has a cathedral church, a liceo, a technical school and a great prison It is near an older city of the same name, the old Roman colony of Potentia in Lucania, which was captured by the Emperor Frederick II, and by Charles of Anjou. An earthquake 16 Dec. 1857 nearly destroyed the modern city. Pop. about 17,938.

POTIDÆA, pŏt-ĭ-dē'ą, in ancient history, a city of the peninsula of Pallene in Chalcidice, founded as a Corinthian colony in the beginning of the 16th century B.C. It was successfully defended against the Persians under Artabazus in 479; in 432 revolted from the Athenian League, thus precipitating the Peloponnesian War, in which it was captured by the Athenians in 429 and occupied by Athenian colonists; was destroyed in 356 by Philip II of Macedon; and was replaced in 316 by Cassandreia, which prospered until its destruction by the Huns.

POTIPHAR PAPERS, The, a series of sharply satirical papers on New York society by George William Curtis, first published in *Putnam's Magazine* in 1853. The papers are somewhat in the manner of Addison's satires on the pretensions and insincerities of society; but at times the bitterness becomes more scathing, and reminds one of Thackeray in its merciless analysis of folly and ignorance. One of the enduring characters is the Rev. Cream Cheese, who sympathetically advises with Mrs. Potiphar as to the color of the cover of her prayer-book.

POTLATCH, among American Indians of the Pacific Coast, a feast often lasting several days, given to a tribe by one of its members who aspires to the position of chief. The word is from the Nootka, meaning a gift, and at the potlatch feast numerous and valuable gifts are distributed among the members of the tribe. The token given at a potlatch is a piece of engraved copper, whose value is usually estimated in blankets. At these feasts the guests are expected to accept whatever is offered, but there is a «string» tied to every gift in that it must be later returned with excess. The wealthy chief who gives a potlatch will sometimes show his distinguished disregard of material values by burning a few hundred blankets, also a few canoes or other property he may have; the more he destroys the bigger chief he is. They have even been known to break up and give away the fragments of a potlatch copper representing a value of many thousand blankets. Consult Barbeau, C. M., 'Du Potlatch en Colombie Britannique' (in Bull. Soc. de Geographic de Quebec, Quebec 1911–12).

POTOCKI, pō-tôts'kē, **Ignanzy,** COUNT, Polish patriot, cousin of S. F. Potocki (q.v.): b. about 1751; d. Vienna, 20 Aug. 1809. He was grand marshal of Lithuania, and united with Malachovski, Kolontady and other patriots in support of the constitution of 3 May 1791. He procured the declaration of the king in its favor, and in 1792 went to Berlin to induce the Prussian court to protect the Poles from Russia. When the Russian troops took possession of the country Potocki fled to Dresden, and was deprived of his estates. In 1794 he returned to Warsaw to engage in the attempt of Kosciusko, and was appointed general and member of the Supreme National Council. After the capture of Warsaw he remained in the city, but was arrested and confined as a state prisoner until 1796. In 1806 he again engaged in public affairs, and exerted himself to effect the abolition of serfdom, and to promote the progress of education among the people.

POTOCKI, Jan, Polish historian: b. 1761; d. Oladovka, 1815. At an early age he formed the resolution of clearing up the obscurity that rested on Slavonic history, and prepared himself for carrying out his resolution by a course of linguistic studies, and by traveling over the lands occupied by Slavonic nations. His chief works are 'Essai sur l'Histore Universelle et Recherches sur la Sarmatie' (1788); 'Histoire Primitive des Peuples de la Russie' (1802); 'Fragments Historiques et Géographiques sur la Scythie, la Sarmatie, et les Slaves' (1794).

POTOCKI, Stanislas Felix, COUNT, Polish patriot and statesman: b. 1745; d. 1805. He adhered pertinaciously to the old constitution of Poland, and exerted his influence against the constitution of 3 May 1791. (See POLAND). Potocki so far forgot his duty to his country as to form connections with Russia, and on 14 May 1792 joined with Rzeuski and Branicki in the declaration at Targovice against the constitution. He then united himself with the Russian army, and was one of the leaders of the Diet of Grodno, which abolished the constitution, and subscribed the act for the partition of the country. He was thought to aspire to the crown, and received important appointments from Catharine II.

POTOCKI, Stanislas Kostka, Polish patriot and statesman, brother of I. Potocki (q.v.): b. 1752; d. 14 Sept. 1821. He distinguished himself greatly by his eloquence in the various diets which were held between 1788 and 1792. When the king acceded to the Confederation of Targovice, and by that false step consummated the ruin of Poland, Potocki retired to Austria; but was arrested there and imprisoned in a fortress. On his release he continued to live in retirement till the creation of the grand duchy of Warsaw in 1807, when he returned to his native country, and as President of the Council of Education applied himself to the promotion of intellectual culture among his fellow-countrymen. When Napoleon gave out that he meditated the restoration of the ancient kingdom of Poland, Potocki's talent and influence were called into action. In 1815 he was appointed Minister for Ecclesiastical Affairs and Public Instruction. He wrote a work on eloquence (1815) and an uncompleted Polish translation (1815) of Winckelmann's work on ancient art.

POTOMAC, pō-tō'măk, a river in the eastern part of the United States, formed by the junction of two rivers on the boundary between Maryland and West Virginia. The river called North Branch rises in the western Alleghanies and the South Branch in the central Alleghanies, and flowing northeast they unite about 15 miles southeast of Cumberland. The North Branch flows southeast from Cumberland for over 100 miles. From the junction of the two headstreams, the river flows generally east-southeast, forming the irregular boundary between Maryland and West Virginia and between Maryland and Virginia, and after a course of over 400 miles enters Chesapeake Bay about 73 miles from the Atlantic Ocean. The chief branches are the Shenandoah from Virginia, and the Monocacy from Maryland. At Harper's Ferry the river breaks through the Blue Ridge, forming a picturesque gorge. There are a number of falls, especially in that part of the course through the mountains. About 15 miles above Washington begins a rapid descent which in two miles is 80 feet and which ends with the Great Falls, a cataract 35 feet high. At Washington the river meets the tide, 125 miles from its mouth; and about 25 miles below it becomes an estuary from two to eight miles wide. It is navigable for large vessels to Washington. The Chesapeake and Ohio Canal is parallel to and near the river the whole length from Georgetown to Cumberland. The Potomac is the most important river in this section of the United States. It was the route whereby explorers journeyed to the interior in the early days, and it has been closely associated with many of the important events in the history of the country. The nation's capitol is on its bank, the home of the first President, and his grave, is a few miles below, and Arlington (q.v.), with its white tombs, may be seen from the Capitol. The drainage area is about 15,000 miles. See BOUNDARIES OF THE UNITED STATES.

POTOMAC, Army of the, a great Federal army in the Civil War, which operated in the East, mainly in the Virginias. It was organized in 1861 by Gen. George B. McClellan. Under him, in 1862, it served in the Peninsula Campaign (q.v.) and later in that of Antietam. Under Gen. A. E. Burnside, who took command in November 1862, it was defeated at Fredericksburg in the following month. In January 1863 command of the army passed to Gen. Joseph Hooker, and at Chancellorsville, in May, it met another defeat; but in July of the same year, under Gen. G. G. Meade, it won the decisive battle of Gettysburg. General Meade continued in command, under Gen. U. S. Grant, throughout the operations of the latter in 1864–65.

POTOMAC, Society of the Army of the, a military organization which grew out of the Civil War. It was founded in New York City 5 July 1869, since when it has held annual reunions. All officers and soldiers who served in the Army of the Potomac and in the 10th and 18th army corps, Army of the James, are eligible to membership.

POTOMAC COMPANY, The, in American colonial history, a land company chartered in 1784, with General Washington as president. It was organized for the purpose of connecting the Potomac Valley with the West by means of a canal, and for general land improvement. The Chesapeake and Ohio Canal Company succeeded it in 1828.

POTOMAC FORMATION, the lowest deposits of the Cretaceous period in America, so-called from the location of some of its typical beds. It is represented by a narrow belt in Maryland, running southward, east of Washington to North Carolina, by strips in New Jersey and in Alabama, Arkansas and Texas. The series has been found to be from 5 to 500 feet thick. It is made up of various sandstones, gravel, sand and clays. Portions of the formation have supplied glass sand, clay (at Amboy, N. J.) and iron ore for manufacturing purposes. Consult United States Geological Survey Bulletins.

POTOSI, pō-tō-sē′, Bolivia, (1) city, capital of the department of Potosi, on the side of the Cerro do Potosi, at an elevation of over 13,000 feet; about 80 miles southwest of Sucre, and 300 miles from the Pacific. It is one of the highest inhabited places in the world. The city owes its origin to the silver discovered in the mountains and at the site of the present city about 1540. The first mine was opened in 1545; the city was founded in 1547; a royal mint was established in 1562 at a cost of over $1,000,000. From the time of the first discovery to 1864 these mines supplied silver to the value of often over $5,000,000 a year; nearly 2,000 shafts were sunk. If the smuggled silver could have been taken into account no doubt the amount would be much greater. The number of mines worked was formerly 300. They are now exhausted. The city is still one of the most important in Bolivia. It has a mint, a cathedral, numerous churches, convents and various public buildings, but the general appearance is dilapidated and unattractive. In the 17th and 18th centuries the population was over 160,000. There are two banks besides the National Bank of Bolivia. Pop. about 24,795. (2) A department of Bolivia, in the southwest, bordering on Chile and Argentina. Area, 45,031 square miles. It is crossed by long mountain ranges; but in the northwest is a low, saline marsh, called «Grandes Salinas.» Many of the inhabitants are Indians. Since the silver mines ran out, there is little industry. Pop. 530,748.

POTOTAN, pō-tō′tăn, Philippines, pueblo, province of Iloílo, island of Panay, on the Jalaur River, 17 miles north of Iloílo. It is well built and contains a large church and a convent. Pop. 14,500.

POTPOURRI, pŏt-poo-rē′, (1) Foods of various kinds, of meat and vegetables, cooked together. (2) A mixture of rose leaves and various spices, kept in jars or other vessels as a scent. (3) A vase or bouquet of flowers used to perfume a room. (4) In music, a medley; a collection of various tunes linked together; a capriccio or fantasia on popular melodies. (5) A literary composition made up of several parts put together without any unity of plot or plan.

POTSDAM, pŏts′dăm, Germany, a district and a city of the province of Brandenburg in Prussia. (1) The administrative district of Potsdam lies between Mecklenberg-Schwerin and Anhalt in the western part of the province of Brandenburg, and is well watered by lakes, and the rivers Oder, Havel, Spree and Ucker, with several connecting canals, and is marked by fine strips of forest and stretches of moorland, and has a flourishing commerce, good fisheries, agriculture and grazing. There are 18 administrative divisions in the district, and

10 electoral districts for the choice of deputies to the Reichstag. Area, about 8,100 square miles; pop. about 2,000,000, of whom 1,800,000 are Evangelical Protestants, 114,000 Roman Catholics, 9,250 members of other Christian bodies and 20,780 Jews. (2) The capital city of the province is situated in its most pleasant and beautiful part, on an island where the Nuthe and several canals and lakes join the Havel, 17 miles southwest of Berlin. Most of the city is well built, with broad straight streets, fine houses, and trees planted in the squares and streets; and the five different parts, the old city or Potsdam proper, and the Berlin, Nauen, Brandenburg and Teltow quarters are connected by bridges, steamers and tramways. Among the city's beautiful squares are the Wilhelmsplatz, with a bronze statue of Frederick William III, by Kiss; the Bassinplatz with Dutch architectural treatment; the Lustgarten with its parade-ground and park and a bronze statue of Frederick William I, by Hilgers, busts of the heroes of the War of Liberation and statues of the generals of the armies of Brandenburg and Prussia and cannons captured between 1680 and 1858; the Old Market with a red and white marble obelisk 75 feet high; and in the narrowest part of the river on the Freundschaftsinsel a place with a bronze equestrian statue of the Emperor William I, by Herter, erected in 1900. The churches of the city, five Protestant and one Catholic, include the Garrison Church planned by Gerlach in 1730 (and rebuilt in 1898), with a tower 295 feet high and the graves of Frederick William I and Frederick II; the Nicholas Church, begun in 1830 and finished in 1850, with a beautiful dome 240 feet high and four bell-towers; the French church, after the Pantheon; the church of the Holy Spirit, with a steeple as tall as the Garrison Church; and the fine Friedenskirche. Among the profane edifices the chief are the Brandenburg Arch, on the lines of the Roman triumphal arch, built in 1750, and leading to Frederick the Great's palace and French gardens of Sans Souci; the palace of San Souci is a low building on fine terraces, its historical associations quite out of all proportion to its poor appearance; the New Palace built at the close of the Seven Years' War; the Marble Palace, the former residence of the Kaiser, situated in a northeastern suburb; northwest of this palace the Pfingstberg, an ornate building with two towers and a fine view. In the extreme northeastern part of the city in one of the broadest expanses of the river lies the large Pfaueninsel (or Peacocks' Island) with a park and a hunting lodge. Woods, hills and the stretches of water everywhere make the city an ideal one.

The city is situated on the Berlin-Magdeburg branch of the Prussian governmental railroad system, and has other rail connections with Berlin. The commerce is comparatively unimportant; there are sugar factories, several breweries, etc. It is an important garrison post, and among the educational institutions of the city are a military school, a war-school for the training of officers and a military orphanage, in which there are 800 pupils. There are also excellent schools for girls, a normal school for women, training schools for gardeners, etc. Pop. 62,243, of whom 5,000 are Catholics and 500 Jews.

Potsdam was a Wendish fishing village founded about 1300, and attained no importance until 1660 when it was selected as a site for a palace by the Great Elector. In 1685 (8 November) by the terms of the Edict of Potsdam he opened the city to the French refugees and made the city his residence. He not only built the palaces mentioned above as his, but erected many private houses to keep up the tone of architecture. Frederick William IV did hardly less for the city's scenic features with the help of Lenné and Meyer. The Peace of Potsdam was signed here 3 Nov. 1805, ratifying an alliance between Russia and Prussia against France.

Consult the works cited under the article BERLIN; also 'Geschichte der Königlichen Residenzstadt Potsdam' (1883) and 'Potsdam ein deutscher Fürstensitz' (illustrated, 1893).

POTSDAM, N. Y., village in Saint Lawrence County, on the Raquette River, and on the New York Central and Hudson River Railroad, about 20 miles from the Saint Lawrence River and 30 miles west of Malone. In 1786 the State of New York created a land commission to further the settlement of the unexplored northern part of the State. Ten towns were established, one of which was Potsdam. Later Garrett Van Horn and David M. Clarkson purchased the town of Potsdam. In June 1803 their agent, Benjamin Raymond, arrived at the place to sell the property. A number of persons from Vermont soon purchased land and settled here. The village of Potsdam was incorporated in 1831. It is in a productive agricultural region, which has had extensive lumbering interests from its foundation. The first industrial establishment built by Benjamin Raymond was a saw mill, and saw mills have been there for over 100 years. In a recent year, one Potsdam company alone had 1,000 men employed in lumber camps in the Adirondacks, and in spring floated down the Raquette River, to the Potsdam mills, 30,000,000 feet of log stock. The village has flour and lumber mills, paper mills, creameries and machine shops. An extension of the water power is being developed in the vicinity. It has an extensive trade in lumber, paper, farm and dairy products, and men's clothing. The celebrated Potsdam sandstone (q.v.) is quarried in the vicinity, and is used in nearly all the large buildings of the town. It has the Potsdam State Normal and Training School, which has a library of 8,000 volumes, the Clarkson School of Technology, founded in 1895, the Crane Institute of Music, a high school and public elementary schools. There are seven churches. The two banks have a combined capital of $200,000. The government is administered by a village president and a board of five trustees elected annually. The village owns and operates the waterworks. Pop. 4,036.

POTSDAM SANDSTONE, an American geological formation of the Cambrian Period of which a yellowish brown sandstone found at Potsdam, N. Y., is typical. The formation was long supposed to be the oldest of Palæozoic time in America, but is now placed at the top of the Cambrian group. It is found to the north of the Adirondacks in New York and in Canada, and in Michigan, Wisconsin and Virginia.

POTT, pŏt, August Friedrich, German philologist: b. Nettelröde, Hanover, 14 Nov. 1802; d. Halle, 5 July 1887. He studied at Göttingen, became a lecturer at Berlin in 1830 and in 1833 professor of the science of language at Halle. His reputation as a comparative philologian was established by his 'Etymologische Forschungen auf dem Gebiet der Indogermanischen Sprachen' (1833–36; 2d ed., 1859–76), and he soon took place with Grimm, Bopp and W. von Humboldt among the students of the newly developed science. His researches were peculiarly thorough; and this fact makes them yet of value despite the advances made in his subject in more recent times. His books, which have been compared, for their want of order, to the plain of Shimar upon the confusion of tongues, include further: 'Die Zigeuner in Europa und Asien' (1845); 'Die quinäre und vigesimale Zählmethode' (1847); 'Die Personennamen und ihre Entstehungsarten' (1853); 'Anti-Kaulen' (1863); 'Die Sprachverschiedenheit in Europa, an den Zahlwörtern Nachgewiesen' (1868); and 'Wilhelm von Humboldt und die Sprachwissenschaft' (1876).

POTT, Percival, English surgeon: b. London, 1713; d. 22 Dec. 1788. He was assistant surgeon in Saint Bartholomew's Hospital, 1745–49, and a chief surgeon there from 1749 to 1787. In spinal diseases he was a specialist, and won distinction by his investigation of angular curvature of the spine, the cause of which he found in a disease of the bones of the spinal column, called after him Pott's disease (q.v.). He wrote a number of works, including 'A Treatise on Ruptures' (1756); 'Fistula Lacrymalis' (1758); 'Practical Remarks on Hydrocele' (1762); 'Some Few General Remarks on Fractures and Dislocations' (1769); and 'Remarks on That Kind of Palsy of the Lower Limbs Found to Accompany a Curvature of the Spine' (1779).

POTT'S DISEASE, an affection of the spinal vertebræ characterized by tuberculous inflammation of their bodies; spinal caries. The nature and cause of the disease were first correctly described by the English surgeon Percival Pott (q.v.), after whom it was named. The inflammation is sometimes followed by total paralysis of the lower limbs. On the diseased parts tubercles form, resulting in disintegration of the vertebræ. A curvature or hump is formed by the visible projection of spinal processes beyond their normal situation. The treatment of the disease must always be hygienic and constitutional, and for surgical treatment special methods are now in general use whereby excellent results are often obtained.

POTTAWATTOMI (pŏt-ą-wŏt'ŏ-mĭ) **INDIANS,** an American tribe of the Algonquian family, early occupied what is now lower Michigan and upper Illinois and Indiana. Joining Pontiac, they surprised Fort Saint Joseph in 1763. During the Revolution they were hostile to the Americans, but joined in the treaty of 1795. The tribe was then composed of settled bands and the wandering prairie tribes. In 1812 they aided England. A few descendants are now living in Kansas and Iowa.

POTTER, Alonzo, American Protestant Episcopal bishop: b. Beekman, Dutchess County, N. Y., 6 July 1800; d. San Francisco, Cal., 4 July 1865. He was graduated from Union College in 1818 and became a tutor there in the following year. In 1821 he was made professor of mathematics and natural philosophy. Of Quaker parentage, he nevertheless studied for the Episcopal ministry and was ordained to the priesthood in 1824. He was rector of Saint Paul's Church, Boston, 1826–31, and then returned to Union College as professor of moral philosophy and political economy, which position he retained until his elevation to the episcopate. He was consecrated bishop of Pennsylvania 23 Sept. 1845, and became known as one of the most sagacious and practical prelates of his day, as well as a man of marked intellectual force and spiritual fervor. His plans of church extension and benevolence were large and costly but he found means to carry them into effect, and not a few flourishing institutions, including the Episcopal Hospital and the Philadelphia Divinity School, owe their origin chiefly to him. Among his published works are several educational treatises and 'Religious Philosophy' (1870), besides sermons and addresses, and the Lowell Institute lectures on natural theology and Christian evidences, delivered in Boston 1845–49. Consult memoir by Bishop Howe (1870).

POTTER, Cora Urquhart (Mrs. James Brown Potter), American actress: b. New Orleans, about 1872. She first appeared on the amateur stage in New York, where she was a society favorite; her professional début was made at the Haymarket, London, as Anne Sylvester, in 'Man and Wife,' in 1887. Later in the same year she played in New York. She made several world tours and assisted in raising funds for the comfort and nursing of British troops in the Boer War. In recent years she has played mostly in and near London. She has written 'My Recitations.'

POTTER, Edward Clark, American sculptor: b. New London, Conn., 26 Nov. 1857. He was educated at Amherst College; studied sculpture under Mercei and Fremo, Paris, 1888–89. He collaborated with D. C. French in sculptures for the Chicago Exposition of 1892–93; executed equestrian statues of Grant at Philadelphia in 1894; Washington at Paris in 1898; Hooker at Boston in 1904; and Derens at Worcester in 1905. The statue of General Slocum at Gettysburg and De Soto at the Saint Louis Exposition of 1904 are also by Potter. He is also represented in the Fulton Library, Washington, the Appellate Court, New York, and the Michigan State House. He executed four groups for the Buffalo Exposition of 1901, two animal groups for the library of J. P. Morgan, New York. Potter is a member of the National Institute of Arts and Letters and was elected a National Academician in 1906.

POTTER, Edward Tuckerman, architect, son of Alonzo Potter (q.v.): b. Schenectady, N. Y., 25 Sept. 1831; d. New York City, 21 Dec. 1904. He was graduated from Union College in 1853 and studied and practised architecture in New York City, giving his attention principally to collegiate and ecclesiastical architecture. He designed and superintended the building of the church of the Heavenly Rest, in Fifth avenue, New York City, the Colt Memorial

Church at Hartford, Conn., the church of the Good Shepherd and the Memorial Hall at Schenectady.

POTTER, Eliphalet Nott, American educator and Episcopal clergyman, son of Alonzo Potter (q.v.): b. Schenectady, N. Y., 20 Sept. 1836; d. City of Mexico, 6 Feb. 1901. He was graduated from Union College in 1861 and from Berkeley Divinity School in 1862, in which year he entered the Episcopal ministry. He was rector of a parish at South Bethlehem, Pa., 1862–69, and professor of ethics at Lehigh University in 1866–71. He then accepted the presidency of Union College and when the college was made a university in 1873 he was elected chancellor. In 1884–97 he was president of Hobart College and in the latter year became president of the Cosmopolitan University, a correspondence school. He wrote 'Parochial Sermons'; 'Washington a Model in His Library and Life' (1895), etc.

POTTER, Henry Codman, American Protestant Episcopal bishop: b. Schenectady, N. Y., 25 May 1835; d. 21 July 1908. He was the son of Bishop Alonzo Potter (q.v.), and was educated at the Episcopal Academy, Philadelphia, Union College and at the Theological Seminary of Virginia. In 1857 he was ordained deacon and in 1858 priest. He was rector at Christ Church, Greensburg, Pa. (1857–58); and at Saint John's Church of Troy, N. Y. (1859–66); then became assistant at Trinity Church, Boston, and in 1868 rector of Grace Church, New York City. In 1883 he was consecrated assistant bishop of New York, and on the death of his uncle, Horatio Potter, in 1887 became bishop. Under his energetic and successful administration, the site for Saint John's Cathedral on Morningside Heights was purchased and funds raised for building. In his decisions on theological questions and controversies he proved himself sagacious and tolerant. He took a deep interest in political life of the city and nation, and wrote and spoke forcefully and freely on a wide variety of educational and political subjects. He lent his influence to promoting friendly relations between labor and capital, and to assisting the reform movement in New York City. His views were extremely liberal. He held that the beer saloon as a poor man's club was a necessity in a great city like New York, and that the church should try to elevate it, and not work — ineffectively — to smother it. In 1904 he established a tavern which was designed to be run as an ethical saloon. It was not well patronized and the newspapers ridiculed it, so it had to be abandoned. He had a great big heart, and did able work among the poor. He published 'Our Threefold Victory'; 'Young Men's Christian Associations and Their Work'; 'The Church and Her Children'; 'Sisterhoods and Deaconesses' (1873); 'The Religion for To-day' (1877); 'The Gates of the East' (1877); 'The Scholar and the State' (1897); 'The East of To-day and To-morrow' (1902); 'Law and Loyalty' (1903); 'The Drink Problem' (1905). Consult Keyser, H. A., 'Bishop Potter, the People's Friend' (1910); Hodges, George, 'Henry Codman Potter' (1915).

POTTER, Horatio, American Protestant Episcopal bishop, brother of Alonzo Potter (q.v.): b. Beekman, Dutchess County, N. Y., 9 Feb. 1802; d. New York, 2 Jan. 1887. He was graduated at Union College in 1826, like his brother studied for the ministry, and was ordained deacon in 1827 and priest in 1828. In the latter year after having held one pastoral charge in Maine, he was elected professor of mathematics and natural philosophy in Washington (now Trinity) College, Hartford, Conn. He was rector of Saint Peter's Church, Albany, N. Y., 1833–54, and was then (1854) elected provisional bishop of New York. His predecessor, Bishop Benjamin T. Onderdonk, after trial before a court of bishops, had been suspended from his office on a charge of immorality, the truth of which, however, he never acknowledged. Thus the diocese remained for some time in an anomalous position, until finally a canon was passed authorizing the election of a provisional bishop. On the death of Bishop Onderdonk, in 1861, Bishop Potter assumed entire charge of the diocese, and ruled it prudently until his own death. The care of such a large and important diocese, especially in the trying times of the Civil War and the ritual controversy, required an unusual amount of courage, wisdom and impartiality. These qualities Bishop Potter exhibited in such a degree as to bring a large measure of unity and peace to New York diocese. His published writings are principally sermons, addresses and pastoral letters dealing with religious and occasionally with civic questions.

POTTER, John, English Anglican archbishop: b. Wakefield, Yorkshire, 1674; d. London, 10 Oct. 1747. He was educated at Oxford, and in 1694 became Fellow of Lincoln College, Oxford. In 1697 he printed an edition of 'Lycophron.' In 1697–99 appeared his 'Archæologia Græca,' or the 'Antiquities of Greece,' which has gone through many editions, and was long indispensable to the classical student. In 1708 he was appointed regius professor of divinity at Oxford, and in 1737 was appointed archbishop of Canterbury. His 'Theological Works' in three volumes appeared in 1753.

POTTER, Louis, American sculptor: b. Troy, N. Y., 1873; d. 1912. His art instruction was obtained under Charles and Montague Flagg. Potter went to Paris in 1896 and studied painting under Merson and Dampt. He executed a number of statuettes, including such excellent pieces as 'The Snake Charmer'; 'Young Bedouin'; 'Tunisian Jewess,' etc. About 1900 he returned to the United States and specialized in American Indian subjects. Of these the best known are 'The Taku Wind'; 'Spirit of the Night'; and 'The Clam Diggers.' Other works are the heroic groups 'Earth Bound'; 'Earth Unfoldment'; and the 'Earth Man'; busts of Mark Twain and de Monvel, and the Horace Wells Memorial, Hartford, Conn.

POTTER, Paul, Dutch artist: b. Enkhuizen, November 1625; d. Amsterdam, January 1654. He came with his father to Amsterdam in 1631, and in 1646 joined the Painters' Guild of Delft and three years later that of The Hague. In 1653 he settled in Amsterdam. Of exceedingly precocious genius he early won a reputation as a painter and etcher, and although he died early takes the first place in the

Dutch school of painting as an animal painter. His life-size pictures such as 'The Young Bull' in the museum of The Hague, and the 'Bear Hunt' in the museum at Amsterdam, have contributed less to his reputation than the smaller canvases, in which are represented cattle, sheep, horses and swine out at pasture. His clear and true color and the fidelity of his drawing and modeling are remarkable. His chief works are 'The Cow'; 'The Sentence of the Beasts upon the Hunters' (at the Hermitage, Petrograd); 'Horse Standing before a Cottage'; 'The Meadow' (Louvre); 'The Shepherd's Cottage'; 'Orpheus and the Beasts'; 'Shepherds with their Flocks' (Amsterdam Museum). The Dresden Gallery possesses two landscapes with cattle, of his, in which the flat fields, peculiar sky and pollard trees of the local scenery are depicted with singular felicity. Most of his pictures are in English galleries. He is also to be considered one of the best etchers of his day. Consult Westrheene, 'Paulus Potter, sa Vie et ses Œuvres' (1867).

POTTER, Paul Meredith, American dramatist: b. Brighton, England, 3 June 1853. He entered journalism, was foreign editor of the New York *Herald* 1876–83, and its London correspondent 1883–84. He was on the editorial staff of the Chicago *Tribune* in 1888 and in 1889 composed his first play, 'The City Directory.' Among his many later plays may be cited 'Our Country Cousin' (1893); a dramatization of 'Trilby' (1895); 'Under Two Flags' (1901); 'Notre Dame' (1903); 'Nancy Stair' (1905); 'Queen of the Moulin Rouge' (1908); 'The Girl from Rector's' (1909); 'Arsene Lupin' (1909).

POTTER, Robert B., American lawyer and soldier, son of Alonzo Potter (q.v.): b. Schenectady, N. Y., 16 July 1829; d. Newport, R. I., 19 Feb. 1887. He studied at Union College; began the practice of law in New York, became colonel of the 51st regiment New York volunteers upon the organization of that regiment, and served with distinction at Newbern, where he stormed the intrenchments on the Confederate left, and at Antietam, where he carried the stone bridge and saved the day. He fought also at Fredericksburg, was made a brigadier 13 March 1863, commanded the second division of the Ninth corps at Vicksburg, and the corps at the siege of Knoxville. Under Grant he commanded his division from the Wilderness to the final attack on Petersburg. He was brevetted major-general in 1863. Retiring from the armv in 1866, he was chosen receiver of the Atlantic and Great Western Railway.

POTTER, William Parker, American rear-admiral: b. Whitehall, N. Y., 10 May 1850. Graduating from the Naval Academy in 1869, he rose steadily in the service, serving several years as flag secretary, both of the North Atlantic fleet and of the European squadron. He took part in the destruction of Cervera's fleet at Santiago, 3 July 1898, and was advanced five numbers for «eminent and conspicuous conduct.» Thereafter he served as commander and captain at several stations, being raised to the rear-admiralty in 1908, and placed in charge of the fourth division of the Atlantic fleet. Later he was chief of the Bureau of Navigation, and in 1912 he retired.

POTTER'S CLAY. See CLAY.

POTTER'S FIELD, the name commonly given a piece of ground usually adjoining a cemetery, and reserved as a burial place for strangers and the friendless poor. The name is derived from its use in the following passage from the Bible: «And they took counsel and bought with them (30 pieces of silver) the potter's field, to bury strangers in.» Matt. xxvii, 7.

POTTER'S WHEEL. The wheel as used by the potter ranks among the earliest mechanical contrivances. The Egyptians classed it among the inventions of the gods and claimed that Num, the creator, fashioned man upon it. As a broad principle the wheel consists of a flat disc, on an upright axle, rotating in a horizontal plane. The primitive form was simply a turn-table. The edge of the disc was made of heavy substance to secure momentum and steady motion. It was rotated by the hand. The Chinese improved upon this by driving by a cord running in a groove. In Europe the favorite device was a lengthening of the axle of the wheel, enabling a heavy disc some three feet in diameter to be placed at the bottom. The potter seated himself at the wheel and propelled it with his foot, working on the lower disc. This was the first form of the «kick» wheel. The next improvement was the application of a crank and handle which was kept in constant motion by one foot. The introduction of power gave rise to two forms of wheel. The special requirement is that the speed of the wheel shall be variable at the will of the workman. This is accomplished either by cones in contact or by a traveling disc, or some similar device. In the former case a cone with a slightly curved face is fitted to the axle, so that it forms the base of the machine. In contact with this is an inverted cone faced with paper or leather and so arranged that the potter can, by pressure of his foot, bring the large end of one cone into contact with the small end of the other or vice-versa. Thus the speed of rotation is completely under control. In the disc wheel the power is applied to a large steel disc revolving in a vertical plane. Upon the shaft of the wheel is a small disc faced with leather and free to move up and down the shaft, but rotating with it. A treadle enables the workman to place this either at the centre or the edge of the large steel disc, thus securing any desired speed. The potter's wheel is fast disappearing. It is now used mainly for shaping blanks, which are afterward pressed into molds, or is employed by the makers of artistic pottery for the sake of the individuality of the work. Stoneware makers also use it for the production of large jars. See POTTERY, MANUFACTURE OF.

POTTERY (from the Latin *potum*, a pot); any article made with clay and fired. The origin of the formation of vessels from clay is lost in antiquity. It was the product of no one nation or people, but resulted from the necessity which arose for articles of domestic use when humankind emerged from savagery to barbarism and communal life was instituted. It required the aid of no metal tool; the fingers of the primitive potter were sufficient to fashion it. Its history cannot be related chronologically and the stages that mark its progress are few. First came the knowledge that clay could be formed into any desired shape and that it hardened by exposure, that this hardness could be materially increased by fire and then some genius discovered the potter's wheel. How long ago is unknown. The Chinese and Egyptians claim its invention and to the latter at least it was legendary, for they represent their god Ptâh as creating the egg of the world upon it. There is a long hiatus before another stage is reached, the production of porcelain by the Chinese early in the Ming dynasty (1368–1644). Followed the use of flint by Astbury (1720) and printing from copperplates (1752).

Ceramic authorities differ considerably in their classification of pottery but it may broadly be divided into three groups: (1) Porcelain — (a) hard or natural; (b) soft or artificial. White and translucent with a vitrified break and a glaze not easily scratched with a knife. Examples: Chinese, Japanese and European porcelains; European potters, unaware of the composition of Chinese porcelain, tried by the mixing of various materials to imitate it, the Medici porcelain (1574) being the first of which we have specimens. The only artificial porcelain to survive is the English bone china. The glaze, fired at a less heat than the body, is softer and more velvety than that of hard porcelain, the colors applied to it sink in the glaze and have not the applied look of those on hard porcelain. Examples: Early Sèvres, Capo di Monté, English bone china. (2) Bodies made wholly or partially from clay, opaque with a non-vitrified break. This includes (a) wares made entirely from clays in their natural state which are found sufficiently pure to use without levigation, which, owing to the presence of iron, manganese or other impurities, cannot be used for white wares and which are termed unwashed clays. Examples: Terra cotta, yellow ware and some ornamental wares where the color of the body is concealed by a glaze or engobe; (b) Faience; the body covered with an opaque (tin) enamel, decorated on either the raw or fired enamel. The term came into use when Italians of Faenza introduced its manufacture at Nevers in the 16th century. When its manufacture ceased toward the end of the 18th century and earthenware made on the English plan took its place, the use of the term ceased, the new body being termed *terre de pipe* or *faiences fines*. Examples: French pottery from 16th to 19th century; Delft, Alcora, etc.; (c) Mezza-majolica and majolica. The former had an engobe of white clay on its surface, the latter corresponded to faience except that it was enriched with metallic lustres. It is so termed because of the supposition that it was made on the island of Majorca, but this is disproved by M. Van de Put, who claims that the trade between Spain and Italy was conducted by Majorcan vessels and traders, the ware taking its name from this fact. Examples: Hispano-Moresque, Italian 15th and 16th centuries. The term is now erroneously applied to wares covered with one or more colored glazes which might be properly called such; (d) white and decorated household wares masquerading as Queensware, white granite, semi-porcelain, ironstone, etc. 3. Stoneware: Opaque with a vitrified break. Examples: Gres des Flandres, Höhr and Grenzhusen wares. Doulton's Lambeth ware. Before quitting the subject it may be well to consider what part clay forms in these divisions. The lowest content is that in English bone china which rarely exceeds 30 per cent; hard porcelain about 40; earthenware from 50 to 60 and stoneware from 70 to 80.

Buried in the dust of untold ages, specimens of the potter's art have and continue to be unearthed, telling us of civilizations before undreamed of. Assyria and Babylon, in the immense library of Nippon, formed of clay cones and tablets, reveal the history and most intimate details of their existence 7000 B.C. The bricks of Babylon were coated with a stanniferous enamel, the secret of which was lost for ages, to reappear in the 13th century when the Moors drove the Arabs out of Spain and established the kingdom of Granada. Egypt on her painted walls at Thebes, 4000 B.C., depicts the whole process of the art, including the use of the potter's wheel, which even then as already said must have been of great antiquity for they represent their god Ptah as fashioning the egg of the world on it. Glazes were early known to them, no less than seven colors being in use about 1500 B.C. The Greeks had obtained a certain technical excellence 2500 B.C. and later proved themselves magnificent potters. There is nothing finer in fictile art than their vases with friezes of figures, each one telling some story of mythology or of their warlike prowess, whilst the exquisite little Tanagra figures are distinguished by an inimitable grace. The art was at its best from 700 to 200 B.C. Much of this pottery which was unknown to Europe until the 18th century was found in Etruria and was for some time regarded as the product of that country, but Etruscan antedated the Greek period, dating from 1000 to 300 B.C., and though toward the close it was imitative of Greece it never equaled it. Etruscan civilization was merged in that of Rome, the natural successors of Greece, and the art was carried on by the Romans until the 1st century of our era. By them it was carried to Gaul, Italy and England and though never equaling that of Greece is distinguished by a black ware obtained by manipulation of the heat during firing and which when made by them in England later became known as Upchurch ware from the site of its manufacture; and by the beautiful Arrentine, or Samian ware as it is erroneously called, a red body, the composition of which has never been determined. Mesopotamia, Crete, Syria possessed a knowledge of lustres, a Rakka bowl bearing a date equivalent to about 790 A.D. though probably later. Persian pottery exerted a far-reaching influence. Their Arab conquerors were not in themselves an artistic race but fascinated by the beauty of the Persian style they largely adopted it and with the modifications demanded by their religion it is known as Saracenic art, the Arabs being known as Saracens during the Crusades. Probably much of the work ascribed to the Arabs was executed for them by Persian workmen. To Persia we are indebted for the beautiful *reflets metalliques*, which possibly may have been the Murrhine vases, those priceless treasures of

Rome of which no positive trace remains. These beautiful lustres made their reappearance during the Renaissance, the secret of manufacture again disappearing until rediscovered in the 19th century.

Before telling how the art was carried into Europe by the Moors another civilization, that of the Orient, demands notice. The Chinese, those indefatigable workers, the acknowledged past masters of the ceramic art, claim an antiquity equal to that of Egypt which until very recent times was not verified by actual specimens, but examples are now appearing lending color to their claims. These examples differ little from those of other countries. The Han dynasty, 206 B.C.–220 A.D., furnishes examples of glazed pottery and from that time progress must have been rapid. Unlike European, Chinese civilization had not halted and the T'ang period, 618–906 A.D., was remarkable for the development of the ceramic and kindred arts. Even life size figures in pottery were made and which European potters a thousand years later considered a great achievement. The pottery of the Sung dynasty, 960–1280 A.D., had disappeared and became legendary in the 16th century, the Ch'ai and Ju wares made famous by Chinese writers. The period marked the introduction of kaolin in the body, not as yet a true porcelain but perhaps best described as a porcellaneous stoneware. It was then that pieces of alternate colors of clay were made, the prototype of the agate ware of Whieldon, Wedgwood and other English potters of the 18th century. We are but just beginning to emulate their elusive *flambé* glazes, the crackled ware and the wonderful colors such as *sang de bœuf* produced by a reducing fire. With their characteristic reverence for age the Chinese have always delighted in reproducing their own past triumphs and so skilfully has this been done that there are but few who may reasonably be classed as experts who can distinguish the difference. The beautiful celadons are also of the period and were the forerunners of true porcelain which was probably produced early in the Ming dynasty, 1368–1644. (See PORCELAIN). While the wares we have but hinted at continued to be produced, they were largely overshadowed by the new body. The great centre of production has since the 7th century been the town of Ching-tê-Chen and in spite of its having been several times destroyed, has always phœnix-like risen from its ashes. The Japanese learned much from the Chinese, as also they did from the Koreans who were responsible for the establishment of the industry at Karatsu (Hizen) end of the 7th century; Satsuma 1457–86; the Raku factories at Kioto 1550; Seto 1590, and later at Haji. It is difficult to understand the Japanese preference for these Korean wares, which in no wise excelled their own productions except for some supposed superiority for use at their tea ceremonies. What merits Satsuma wares possess is due not to Korean but to Japanese influence, the art instinct being prompted by the work of the Chinese, whom they soon began to rival. Practically no good pottery was made in Japan until Kato Shirozayemon, called Toshiro, finished his five years' studies in China and came to Seto in 1200. Porcelain was not made until about 1513. Having obtained mastery of the art it spread all over the kingdom and was patronized and encouraged by emperors, princes and potentates. Two distinct styles are apparent, that made for use at home and that intended for export. The so-called old Japan, imitated and copied by nearly every manufacturer in Europe, is an example of the latter. Japanese pottery is largely the work of an individual or at least of a family, while Chinese is the result of combined workmanship. This individual work of recent years has been largely superseded by that of factories which to the great debasement of the national art have been induced to copy European designs with a result, with the single exception of price, disappointing and regretable. There remains, however, a number of artist potters who refuse to prostitute their talents, such as Miyagawa, Kozan, Seifer, Sobei, Watano and others. Even this glimpse of Japanese ceramics would be incomplete without reference to the great Imari artist Kakiyemon whose isolated designs on a white ground inspired the beautiful productions of present day Copenhagen porcelain and to whom many of the early European factories were largely indebted.

African pottery was made at Bagdad in the 9th century and at Cairo in the 11th, the Moors having obtained their knowledge from the Arabs, largely adopting the style of the Saracenic potters. In the 8th century the Arabs conquered Spain but no ceramic specimens definitely assigned to them at this period are known. Five hundred years later, 1235 A.D., the Arabs were driven out of Spain by the Moors and the wares known as Hispano-Moresque began to appear, the most notable example being the Alhambra vase made about 1230 The production continued until the 15th century, though its Moorish characteristics were gradually disappearing through coming into contact with Christian art, the late examples consisting of decorations of mock Arabic characters, with borders and diapers of leaves, principally of the vine and briony. The Moors had found in Spain a plentiful supply of tin and abandoned the calcarous covering they had hitherto employed in favor of a tin enamel and which they enriched with brilliant lustres. As the wares lost their Moorish character, so the application of the lustre changed until finally it degenerated into a ruddy copper. Much of this pottery found its way into Italy and it is probable that a Moorish potter gave assistance to Lucca della Robbia who in 1440 produced the first white enamel made in Italy. This led the way to those later triumphs in Italian ceramics which culminated in the period 1470 to 1530, a period remarkable for its awakening from the oblivion of centuries and one of the most splendid epochs of the ceramic art. The painter had recognized in della Robbia's invention a material on which his art could be preserved for all time and loyally backed by the reigning houses, the princes of Urbino, of Pesaro and Florence, the Sforza, the Montefeltros, the Medici and the Fontanas, he found the opportunity to express himself. These artist potters were the heroes of the moment; they were created maestros, entitling them to rank with princes. Never was an art so honored, so worthily expressed, and from the great centres at Castel-Durante, Urbino, Faenza, Gubbio and many other places there was a constant producing stream. This

Italian majolica was practically an art expression confined to placques, vases, etc., and was not applied to utilitarian articles if we except the drug pots of the period. That came later when Italian workmen carried the art to France and in 1578 when the Nevers works were started. Except for the use of the tin enamel it had nothing in common with Italian majolica and in the early part of the 18th century had so degenerated as to become grotesque. Nevers pottery is important only on account of its extent. Toward the middle of the 17th century Rouen came into prominence and in the early part of the 18th century potteries had become very numerous. Several distinct styles of decoration were introduced, owing nothing to foreign influence, and the industry received an impetus which extended all over France, some of the principal places being Moustiers, Marseilles, Lille, Strassburg and Bordeaux, and literally hundreds of other places had their small potteries. The most original of those mentioned was Moustiers; for the rest they relied for inspiration on the parent factories — Rouen stands pre-eminent, the faience produced there being characterized by the loftiest art ideals, combined with perfect workmanship. Another important pottery centre owing its influence to the Normandy potteries was at Alcora in Spain, which was of great extent, but which seems to have been somewhat neglected by ceramic writers. Delft in Holland came suddenly into life at the commencement of the 17th century and a tremendous trade was built up. Some English potters are known to have worked there, but the inspiration was no doubt Italian, for as early as 1560 Peccol Passo of Urbino had established at Antwerp a pottery for making Italian majolica so that the use of the tin enamel would be known to the Low Country potters. The manufacture of white ware in England, its superiority for use and durability and in the case of France the lowering of the duties on its importation, brought the manufacture of faience to a close. Recent years have seen the reproduction of much of the faience of the 17th and 18th centuries, their incontestable artistic merit being highly valued by refined connoisseurs.

After the collapse of the faience industry the manufacture of earthenware on the English plan was introduced. Many English potters assisting in perfecting it. The principal factories were Choisy-le-Roi, Creil, Montereau, Chantilly and Sarreguemines. Ware of good quality was made for a time but gradually deteriorated and the industry faced extinction, but was rescued by a scientist, M de St. Amans, who with the assistance of Brongniart succeeded in again placing it on a sound basis. About the middle of the 19th century there was a remarkable art revival as applied to ceramics which has practically revolutionized the pottery of France. The stoneware of Claude Louis Ziégler (1840-54), so pure in form and decoration, was perhaps the first evidence, followed by the remarkable reproductions of Palissy ware by Charles Avisseau of Tours (1842), his example being followed by Barbezet (1850) and Pull (1855), both of Paris. From 1854 to 1871 Sèvres took the lead and a great impetus was given to the movement. In 1859 Theodore Deck, the greatest of French ceramists, demonstrated that the secrets of the Orient were secrets no longer and he appeared to be able to duplicate at will the lustres of the Persians, the celadons of the Chinese, the intricacy of Hispano-Moresque or the inlaid work of Oiron. Still more recently an apparent army of artist potters have given expression to their ideals in grès, the royal factory assisting in the movement and restoring France to the position she seemed in danger of losing. No account of French pottery would be complete without reference to the work of Bernard Palissy and the faience of Oiron, though neither appears to have exerted any influence on French ceramics — Faience d'Oiron was made under the direction of Hélène de Hangest by her librarian, Jehan Bernart, and François Charpentier and consisted mostly of small pieces, the decoration formed by inlaying different colored clays. The work was executed in a marvelous manner, so well, indeed, that for centuries it was impossible to reproduce it; and owing to many of the late pieces bearing the monogram of the Dauphin (Henry II) it was long known as Henry deux ware. Its manufacture extended from 1524 to the middle of the century but the late period is much inferior to the early one. Some 50 or 60 specimens are known, each worth more than its weight in gold. Bernard Palissy, a land surveyor, a glassmaker, a portrait painter, but poor withal, became obsessed with the idea of discovering the art of making enamel. Against difficulties and privations, disappointments without number, he struggled against a fate which threatened to overwhelm him, continuing his experiments for over 16 years, until at last success rewarded him and the secret of the enamel was discovered. The time of his triumph was also one of the greatest despair, for reduced to absolute penury, his credit exhausted, reviled by his neighbors as a madman, he could not procure fuel to finish the firing of his kiln and in a frenzy tore down the doors of his house, broke up and fed to the flames what little furniture was left him in the house, his mad act rewarded at last by success. He died in 1589.

In England tin enamel never seems to have obtained much popularity. No pottery worthy of record with the exception of the Encaustic tiles made by religious orders in the 14th and 15th centuries occurs until the awakening of the Staffordshire potters in the 18th century. We are not forgetting the quaint slip-painted wares of Wrotham and Staffordshire which were but the expression of the rude art of the old English potter who had no materials beyond his clay to work with, but rude as that art was it is the prototype of the most difficult and most beautiful ware of the end of last century, pâte-sur-pâte.

The advent of Elers who came to England in the train of William of Orange and had a small pottery at Bradwell Wood prior to 1698 is generally spoken of as the beginning of Staffordshire pottery, but as before his arrival there John Philip Elers is known to have been in litigation with some of these Staffordshire potters for infringing his rights there appeared at least to be an awakening for something better than the rude butter pots of their forefathers. Certainly Elers by his refined processes stimulated competition; and when his carefully guarded secrets had been mastered by Astbury and Twyford and by them freely communicated

to their brother potters, the establishment of an important industry was laid. Whether the Elers introduced salt glazing in England is a moot point, but the process became prevalent at this period. Unlike the *gres de Flandres* it was extremely light in weight, much of it was beautifully designed and although the glaze was soft and scratched easily it made excellent tableware. Not content with the successes achieved the Staffordshire potter was but spurred on to further effort. New clays were searched for and tested in an endeavor to produce a white body and when in 1720 Astbury discovered the invaluable use of flint, the end was practically obtained. It gives both strength and whiteness, the two qualities hitherto lacking. Other discoveries rapidly followed but it was given to one man, Josiah Wedgwood, whose forbears had played no unimportant part as pioneers, to systematize and turn into a manufacture. Much had been done already. Whieldon (1740–98) had greatly improved the body; Dr. Thomas Wedgwood (1731) had invented the agate ware; Booth (1750) introduced the dipping of ware in glaze held in suspension in water; plaster molds had superseded pitcher and brass ones and others had added their quota. Wedgwood (1730–95) organized and systematized all that had gone before; he labored assiduously to improve all existing processes as well as communications with the outside world which were in a deplorable state and in doing so not only enriched himself, but benefited the community at large. He invented a new body employing a material hitherto unused in pottery, barytes, and which he called jasper. In this body he produced a series of vases ornamented with classical designs for which at the time there was a great vogue and which generally are regarded as his greatest work. These designs made by the best artists obtainable were made in white clay in slight relief in molds and afterward applied on the colored jasper. They are marvels of skilled workmanship. From this time English earthenware has steadily advanced, such men as Spode, Minton, Davenport, Ridgway, Adams and a host of others worthily maintaining its prestige. With the exception of Davenport the descendants of these men are still in business and to them must be added the name of Doulton who first as a manufacturer of stoneware at Lambeth and later at Burslem shares honors with the older firms. Whilst «The Potteries,» the five towns of Arnold Bennett, Stoke, Burslem, Hanley, Tunstall and Longton, were the centre of production the manufacture generally extends all over the country, Liverpool and Leeds, which formerly produced extensively, are now extinct. In the United States nothing beyond spasmodic attempts had been made until the middle of the 19th century Taylor and Speeler starting to make white ware at Trenton in 1855 resulting in the establishment of a pottery centre there. At East Liverpool from 1840, yellow and Rockingham wares were extensively made and in 1872 Knowles, Taylor and Knowles commenced making white wares, many other manufacturers following their lead. The use of natural gas as a cheap fuel and other causes has centred the pottery industry to the detriment of Trenton, and potteries have cropped up in the surrounding neighborhood. Probably the largest in the world, Laughlins, is situated at Newall, W. Va., on the opposite side of the Ohio. Up to 1876 practically nothing but white ware was produced and that of a mediocre character, but of late years a decided change for the better has taken place and we now successfully compete with the products of the Old World. There is, it is true, a certain family resemblance in all makes owing to the extensive use of decalcomanies which of necessity are procured from sources open to all. By and by American manufacturers will recognize the value of originality and individuality and perhaps evolve a distinct American style. Mention must be made of the so-called hotel ware, a hard durable body possessing the best qualities of both porcelain and earthenware, first made by the Greenwood Pottery Company, Trenton, in 1863 and now extensively made by many firms. In art pottery the name Rookwood inevitably suggests itself. Born in the brain of a woman, Mrs Bellamy Storer, in 1880, it has been praised by critics the world over and it at its inception was worthy of such. Present-day Rookwood is much more so for it is dominated by a loftier art ideal. The naturalistic style of painting has given place largely to a more conventional one and the whole has become more ceramic. The Grueby pottery at Boston was responsible for some of the most artistic pottery conceivable, the restraint in ornament, the beauty of the matt glaze being beyond criticism. The manufacture is now principally confined to tiles. These are the only two art potteries in America, but the women have largely made up any deficiency, the pupils of the Sophie Newcombe College, New Orleans, producing wares almost on a commercial scale, so well designed and executed as to undoubtedly place them in the first rank. At Zanesville, Ohio, a large quantity of ornamented pottery is made, the best of which is the multi-colored glazes of the Roseville Pottery Company, extraordinary in the beauty of their color and challenging comparison with some of the best examples of Oriental art. Mention must also be made of the slip wares of the Pennsylvania Dutch of the last half of the 18th century; crudely conceived and executed but interesting for its individuality.

South America did not fail to contribute its quota, the truly remarkable pottery of Peru showing a civilization at a time so remote that it is doubtful whether it was the work of the Chinese or some older race of which we have no knowledge. In the 16th century Peru and other countries were sending to Portugal pottery impregnated with a delicate perfume which became known as Noble Buccaros and about which many fantastic properties were invented, among others that if ground up and eaten it was a sure cure for all ills. An English firm claims to be able to reproduce them but no specimens have come under our notice.

Germany has always been noted for its stoneware, much of the *gres de Flandres* being made there, gaining its name from the fact that it was shipped from Flemish ports. The Hirschvogels of Nuremberg, the numberless potters of Höhr and Grenzhusen were pioneers in the work and modern firms with added knowledge have continued the work. Ceramic literature is of a most voluminous character and only a few works can be indicated which will serve as an introduction to more intensive reading. Consult for Egyptian, South Kensington and Bristol Museum Catalogs; *Greek,* Walters, 'History of Ancient Pottery'; *Hispano-Moresque,* Van de Puts, 'Hispano-Moresque Ware of the 15th Century'; *Italian,* Fortnums, 'Majolica' and other works by the same author; *French,* Gasnault and Garniers, 'French Pottery'; *English,* Llewellyn Jewett, 'Ceramic Art in Great Britain'; M. L. Solons, 'Art of the Old English Potter'; Burton's 'English Earthenware and Stoneware'; *Chinese,* Bushell's 'Oriental Ceramic Art'; *Japanese,* Audesley and Bowes, 'Keramic Art of Japan'; *General Introductory,* Jervis's 'A Pottery Primer'; *Technical,* Segers, 'Complete Works'; *Manufacturing Processes,* Sandemans, 'The Manufacture of Earthenware'; *Marks and Monograms,* Burton's 'Marks on Pottery and Porcelain.'

William P. Jervis,
Author of 'The Pottery Marks of the World,' etc.

POTTERY, Manufacture of. Clay in itself is not sufficient to make good pottery. The materials used for mixing with it are flint, Cornish stone and feldspar. The first process is to reduce all these materials to a common fineness by means of grinding and levigation. These in their proper proportions are mixed with water, the resultant liquid mass being known as slip. If plastic clay is required the slip is pumped into a clay press. The press consists of a number of what are termed chambers lined with very heavy cloth into which the slip is forced, pressure is brought to bear on them and the water expelled, leaving the clay mass inside the cloth or «bags.» The presses are then opened, the clay taken from the bags, but as it may not all be of exactly the same consistency a further process is necessary. This was formerly done by cutting off pieces with a wire and dashing it down on another piece until the whole was of the same density and moisture, and was known as wedging. This is now done by the pug mill, a cylinder down which runs an axle to which are attached blades of iron set at such an angle that they not only cut the clay but force it forward at the same time until it comes out at the bottom in a solid block about 6 × 4 inches. It is now in a plastic state ready for either the thrower or the presser. Throwing is perhaps the most fascinating operation in all the industrial arts. Taking a ball of clay the thrower throws it on a revolving horizontal wheel and grasps it on the side with hands held rigid, which forces the clay to the exact centre. He then with an upward pressure raises it into a cone and when this has been repeated once or twice inserts his thumb in the top to make the aperture, and according to the shape required so guides and gently forces the clay to the proper contour entirely by the use of his fingers. Watching a skilled workman, the clay appears as if imbued with life, obedient to his slightest wish or thought. There is, however, a good deal of nonsense talked about the expression of the thrower's individuality, and whilst this may be true of the few craftsmen who have mastered the process, it is ridiculous as applied to commercial wares, for when the individual work of the thrower is finished it is passed on to the turner, who places it on a horizontal lathe and turns out all the marks of the potter's thumb and fingers until it assumes the exact size and shape required, no better and no worse than if it had come out of the mold. The process is very little employed to-day. For the presser much preliminary work must be done. An artist must design a shape, a model of it must be made and from this model must be made the molds, so constructed that the different parts of them lift cleanly away from the clay inside. Taking these molds, the parts held firmly together with a strap, the presser lines them with bats of clay, which he presses firmly down and then sponges the inside to make it smooth. Evaporation causes the clay to harden and the particles to shrink more closely together, and the piece can then be removed from the mold. If it requires a handle it is passed to the handler who presses the handles from molds and then with a little water or slip adjusts them to their proper place. Plates, saucers, etc., are made by machinery, but the principal is the same, the molds being fixed on a revolving disc, which greatly facilitates the work. The ware is now in the «green» state, and when thoroughly dry is ready for the first firing, after undergoing which it is called biscuit ware, the first form of pottery. If instead of the plastic clay slip is used it is poured into a plaster mold, which being made somewhat softer absorbs some of the water, the clay particles floating to the side. The mold is kept full of slip until the requisite thickness is attained, the surplus slip is emptied out and the mold put away until the piece frees itself by shrinkage. All mold-made pieces require fettling, that is, the mold marks are removed with a knife or sponge. Biscuit ware can be decorated either by painting with a brush or by printing. The former enables the artist to express himself just as on canvass, except that his colors will be absolutely permanent. For printing, the design is engraved on a copper plate; an impression on thin paper is obtained from this and transferred to the ware, the paper being afterward washed off. In both cases the colors are mixed with oil, and to remove this the ware is fired in the «hardening on» kiln before the glaze is applied. Biscuit ware may also be dipped in a plain or colored glaze, which simply requires the «glost» fire to complete. The glazing is done by immersion in a tub of glaze, the dipper holding the piece with the least possible contact with his finger and quickly and dexterously plunges it in the glaze, which covers it all over with a thin film. It is now ready for its final firing. In the biscuit kiln it is immaterial whether one piece touches another, but this would be fatal to glazed pieces, which are separated by means of separators called stilts, spurs, pins, etc., according to how they are used and which are easily removed when the firing is finished. A biscuit kiln will hold from 1,500 to 2,000 dozens of ware and takes from 45 to 50 hours to cool. A glost kiln does not take so long, the clay ware requiring a greater heat than the glaze. If the biscuit ware has been glazed and fired it can be decorated in a number of ways, either by painting with the brush, by applying decalcomanies or by printing. The colors used in this case are heavily fluxed and only require a fire of about 8 to 10 hours. The average Centigrade heat for biscuit ware is 1,270°, for the glaze 1,210° and for decorations on the glaze 840°. The heat conditions in the kiln were formerly determined by the color and the withdrawal of certain trials, but small triangular cones made to melt from the lowest to the highest heat are placed in the kiln within view of the fireman and when the heat they represent is reached they bend and melt, showing that the firing is finished.

William P. Jervis,
Author of 'The Pottery Marks of the World,' etc.

POTTSTOWN, Pa., borough, Montgomery County, on the Schuylkill River, and on the Pennsylvania and Philadelphia and Reading railroads, 40 miles northwest of Philadelphia. It was laid out as a town in 1752 and was at first named Pottsgrove, after its founder, John Potts; in 1815 it was incorporated as a borough and renamed Pottstown; the boundaries of the borough were increased in 1888. It is the trade centre of a fertile agricultural region. The immediate vicinity possesses considerable mineral wealth and as a result Pottstown has grown to be of importance as an industrial centre. Though at the time of the last United States census Pottstown was only 39th in size amongst the cities of Pennsylvania, it was 18th in volume of products manufactured in its 78 industrial establishments. The total value of these products in 1909 amounted to $12,205,000, an increase of 68 per cent since 1899. The capital invested in these industrial establishments was almost $10,000,000, and the number of persons engaged in industrial pursuits was 4,123, more than 25 per cent of its total population. The borough is especially noted for its manufactures of iron and steel; it contains rolling mills, blast furnaces, steel mills, bridge works, boiler works, nail factories and manufactories of agricultural implements; also cigar factories, carriage works, planing mills and creameries. It has a public high school and library as well as a number of private educational institutions, the best known of which is High School, a non-sectarian secondary school for boys. Pop. 15,599.

POTTSVILLE, Pa., borough, county-seat of Schuylkill County, on the Schuylkill River, near its source, and on the Pennsylvania, the Lehigh Valley, the Philadelphia and Reading and the Central of New Jersey railroads, 95 miles northwest of Philadelphia. It was first settled in 1800, incorporated in 1828 and made the county-seat in 1851. It is situated among the Schuylkill anthracite coal fields and is one of the most important mining centres and shipping points of the region. Its manufacturing interests are also of considerable importance. The total value of products manufactured in 1909 in its 91 industrial establishments amounted to $9,138,000, an increase of 99 per cent since 1899. The capital invested was $13,982,000, and the number of persons employed 3,342, 16 per cent of the total population. Its industrial establishments include steel mills, blast furnaces, rolling mills, foundries, planing mills, cotton-velvet and silk mills. It was in Pottsville that anthracite coal was first successfully used in smelting iron ore. Among its more important buildings are the county courthouse and jail, a public hospital and the Pottsville Athenæum. The latter contains a library and the borough also has a public library as well as the county law library. There are a public high school, public and parish graded schools and some private educational institutions. The chief executive officer of the borough is a burgess, elected for three years; the legislative body is a borough council, possessing the power of appointing many of the city officers; the city auditor, city treasurer and the school directors, however, are elected by the people. Pop. 20,236.

POTTSVILLE CONGLOMERATE, the name by which the Millstone-Grit at the base of the Pennsylvania series (coal measures) is generally known in Pennsylvania, because it has its greatest development at Pottsville, near the eastern edge of the anthracite fields. It is there more than a thousand feet thick, but toward the west and north grows thinner. The rock is composed of sand and pebbles, chiefly of quartz, giving it considerable hardness.

POTVIN, pō-văṅ, **Charles**, Belgian author: b. Mons, Belgium, 2 Dec. 1818; d. Ixelles, 1 March 1902. He was educated at the Catholic University at Louvain, became professor of national literature at Brussels, in 1883 conservator of the Wiertz Museum there, and in 1881 a member of the Belgian Academy. He was editor of *La Nation* in 1850–53, and in 1862 became editor of the *Revue de Belgique*. For many years he was the recognized leader of the Liberal party in Brussels. His writings comprise volumes of verse, history, political philosophy and criticism, including 'L'Eglise et la morale' (1858, under the pseudonym Dom Jacobus); 'Le Roman de Renard' (1860); Marbres antiques et crayons modernes' (1862); 'Jacques d'Artevelde' (1861); 'L'Histoire des lettres en Belgique' (1882); and 'L'Art Grec' (1895).

POUCHED DOG. See Dasyure.

POUGHKEEPSIE, po-kip'si, N. Y., city and county-seat of Dutchess County, on the eastern bank of the Hudson River, 72 miles north of New York, midway between the Highlands and the Catskills, and on the New York Central and Hudson River and the Central New England railroads. A ferry connects it with the West Shore Railroad. A cantilever bridge carries the Central New England lines across to the west bank of the river. Poughkeepsie has an elevation of 200 feet and a mean annual temperature of 50°. The city is the seat of Vassar College (q.v.), of Glen Eden Seminary, Putnam Hall, Eastman Business College, Adriance Memorial Library, containing over 40,000 volumes, the Hudson River State Hospital for the Insane, Vassar Brothers' Institute, Vassar Brothers' and Saint Francis hospitals, Pringle Home, Columbus Institute and Riverview Military Academy. College Hill Park has an area of 100 acres and is finely situated, commanding a magnificent view of the Hudson. The Intercollegiate regatta is an annual event in June. There are four national banks, one trust company and one savings bank, with total resources of $30,000,000. There is also an active Chamber of Commerce of 822 members and having an annual income of over $22,000. The assessed value of property subject to taxation is as follows: Real property, $24,844,845; personal property, $956,650; special franchise, $1,387,680;

shares of bank stock, $1,573,047. The city's funded debt is $2,135,000. The total tax rate is $25.97 per $1,000 valuation. There are 55 lines of manufacture in the city with products having an estimated total value of $15,000,000 and employing over 5,000 people. There are, all told, 176 establishments, employing 5,580 persons; of the latter 147 are proprietors and firm members, 704 are salaried employees and 4,729 are wage-earners. The capital invested aggregates $13,935,000; wages, $2,284,000; salaries, $1,039,000. The cost of materials used aggregates $6,115,000, and the value added by manufacture, $6,676,000. The chief manufactures are mill supplies, underwear, trousers, cigars, candied fruits and preserves, cream separators, foundries, knitgoods, celluloid articles, skirts, infants' garments, ball bearings, auto specialties, children's dresses, machine-shop products, linen and cotton mesh, shoes, ivory buttons, piano and organ players, dyes, etc. In September 1917 the average wage of 44 concerns employing men in Poughkeepsie was $16.01, and the 25 concerns employing women $9.90 per week. There are 11 grade schools with 5,500 pupils, five parochial schools, a $250,000 high school with 1,100 students. About $150,000 represents the municipal annual outlay on education. Poughkeepsie has steamer connection with Albany, New York and other Hudson River points. It is also a terminal point on the State canal system. What is now termed the city of Poughkeepsie dates far back of definite records. Its name is found in an Indian deed of date 5 May 1683, granting to Pieter Lamsingh and Jan Smeedes each a farm, and to the latter also a waterfall near the eastern bank of the Hudson, to build a mill thereon. The waterfall is called *Peoghkepesingh* («the place where the water breaks through»). A Dutch settlement sprang up about 1698, and during the Revolutionary War the place was a base for the Continental armies. In 1778 it became the State capital and in 1788 the Federal Constitution was ratified at a State convention held here. In 1799 it was incorporated and in 1854 was chartered as a city. The present charter was granted in 1874. Under it the people elect a mayor, a common council of 14 members and an alderman-at-large, who is president of the council. Pop. 32,000. Consult Platt, E., 'Eagle's History of Poughkeepsie' (Poughkeepsie 1905).

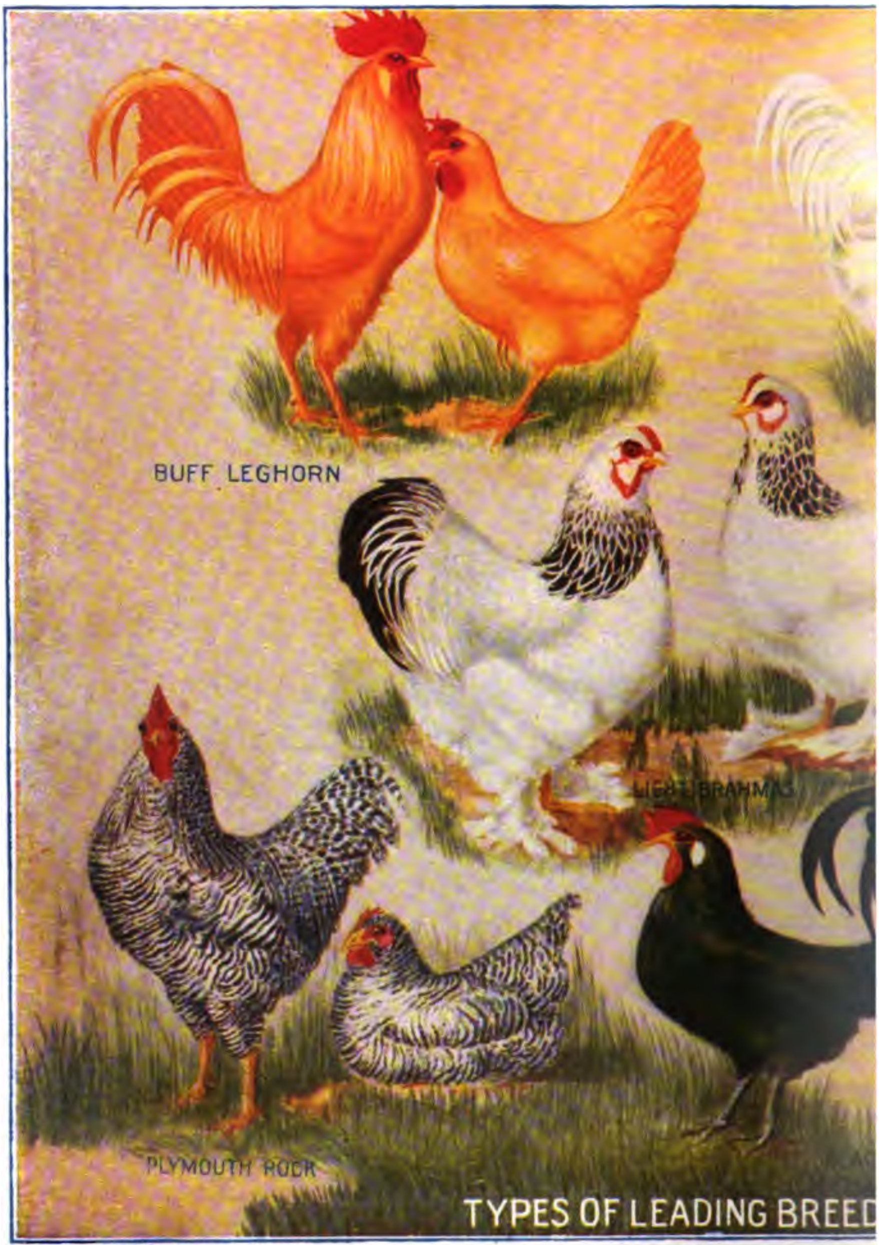
POULSON, pōl'sŏn, **Niels**, Danish-American architect, ironmaster anl philanthropist: b. Horsens, Denmark, 1843; d. 3 May 1911. He studied architecture and building at Copenhagen and came to the United States in 1864. He was for two years employed in the United States government supervising architects' office at Washington and afterward was in charge of the architectural and engineering departments of the New York Architectural Iron Works. He engaged in business in partnership with C. M. Eger in 1876, the firm being incorporated as the Hecla Iron Works, New York, in 1897. Poulson was an active promoter of the welfare of his employees, a free technical school was established by the company and many of the men were enabled to establish themselves in business. He was also desirous of a closer understanding between the United States and Scandinavian countries and in 1910 gave $100,000 to be expended in an exchange of lecturers and students. His fortune, amounting to about $500,000, was left to the same cause and resulted in the establishment of the American-Scandinavian Foundation and the American-Scandinavian Society. Scholarships for Scandinavian students were established at Harvard, Yale, Columbia and the Massachusetts Institute of Technology; while those for American students were at Christiania, Copenhagen and Upsala.

POULTNEY, pōlt'nĭ, Vt., town, Rutland County, on the Poultney River and Lake Saint Catherine and on the Delaware and Hudson Railroad, 18 miles southwest of Rutland. It is in an agricultural region; slate is quarried in the town and vicinity and there are slate manufactures, a foundry and machine shops. It is situated in a picturesque country in the Green Mountains and the lake affords facilities for boating and fishing; consequently the town has become popular as a summer resort and contains several hotels. It has a public high school and is also the seat of the Troy Conference (Methodist) Academy. Pop. 3,644.

POULTON, Edward Bagnall, English scientist: b. Reading, Berkshire, 27 Jan. 1856. He was educated at Oxford and was demonstrator in the anatomical department of the University Museum 1877–79, and lecturer in natural science at Keble College 1880–89, as well as at Jesus College 1880–89. In 1889 he became a Fellow of the Royal Society and since 1893 has been Hope professor of zoology at Oxford. He was vice-president of the Royal Society 1909–10, president of the Linnæan Society of London 1912–16 and is a member or correspondent of many scientific societies. He delivered a course of lectures before the Lowell Institute, Boston, Mass., in 1894 on 'The Meaning and Use of Colors in Animals.' He is the author of 'The Colors of Animals' (1890); 'Charles Darwin on the Theory of Natural Selection' (1896); 'Essays on Evolution' (1908); 'Charles Darwin and the Origin of Species' (1909); 'Viriamu Jones and other Oxford Memories' (1911); 'Hope Reports' (Vols. I–IX, 1897–1913), etc.

POULTRY. A term designating collectively all birds which have been domesticated for their flesh, eggs or feathers, for fighting or for pets, including fowls, ducks, geese, swans, turkeys, guineas, peacocks and pigeons. The word «fowl» once included wild game birds but now applies only to the domesticated fowl (*gallus domesticus*) and does not properly include turkeys, guineas or pheasants which belong to a similar genus (*Phasianus*) which are now kept in semi-captivity and are only partially domesticated.

Origin.— The common fowl which makes up the largest class of domestic poultry is supposed to have originated in southwestern Asia. Darwin believed all domestic fowl to have sprung from a single species, the wild jungle fowl (*gallus bankiva*) which still is found in the jungles of India in the wild state. His belief was founded upon the fact that *gallus bankiva* closely resembled the common Black Breasted Red Game of to-day, one of the oldest varieties of domestic fowl known; that it crosses readily with the common hen, producing fertile offspring; that it resembles the domestic fowl



TYPES OF LEADING BREED

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JAPANESE BANTAMS
WHITE WYANDOTTE
MODERN GAME
MINORCA
RHODE ISLAND RED
S OF AMERICAN PURE BRED FOWLS

in voice and action; that it is readily domesticated and that according to his observations it produced sterile offspring when crossed with other species of wild fowl and that sterile offspring resulted when other wild species were crossed with domestic fowl. On the latter two points it is believed that Darwin was in error and that many varieties of common fowl have descended from several wild species and their crosses. In support of the belief it is known that several domestic varieties bear a much closer resemblance to other wild species than do *gallus bankiva.* The Oriental games, for example, resemble *gallus giganteus* much more closely than they do *gallus bankiva;* indeed, the *gallus giganteus* kept in domestication by the natives of the Malay Peninsula at the present time are so like the Malay breed of our domestic fowl that they might be considered the same. Among the wild fowl now in existence which may have contributed largely or in slight degree to the foundation of the common fowl are *gallus bankiva* or (*gallus ferrugineus*) from southern India only; *gallus sonneratii,* found in Hindustan; *gallus fercatus* from Java; *gallus stanleyi* from Ceylon; *gallus giganteus,* the Kulm fowl of the Malay peninsula, and others not so well known.

The principal characteristics of the domestic fowl are as follows: Beak, heavy; gullet enlarged to form a crop; small stomach; gizzard strong to crush hard seed; two long sæca; body temperature 105 to 106, varying slightly according to temperature of the environment; feet adapted to scratching, running and perching; wings not suited to long flight; gregarious; polygamous; domestic in the extreme; prolific; period of incubation 21 days; young covered with down and able to run about as soon as hatched; brave in defense; flesh and eggs prized as human food.

History.— Fowls are the oldest of our domesticated animals so far as history records. The earliest record is to be found in a Chinese encyclopedia compiled from ancient documents, where it says «fowls are creatures of the west.» Fowls were introduced into China 1,400 years B.C. and the Chinese considered the Indian region as their source. They were also mentioned by Aristophanes between 400 and 500 B.C., and it is said are figured on Babylonian cylinders between the 6th and 7th centuries B.C. Mention of fowls is also made in the writings of the Greek and Roman authors Theognis, Aristotle, Diodorus, Æschylus, Plutarch, Plato and Pliny, and are supposed to have been taken into the British Isles by the Romans, who regarded them as sacred to Mars. The cock has in all ages occupied an exalted position as an emblem, symbolizing courage among the ancient Gauls and afterward among the French, who used it on their ensign after the Revolution. It figures also in the Bible and has been used in Christian art to symbolize the Resurrection. At the present day it is regarded by political parties as a herald of victory.

Extent and Importance of the Poultry Industry.— Poultry husbandry is an old art and a comparatively new science for it is only within the present century that special attention has been given to raising poultry as a commercial enterprise and only within the past generation has any real effort been made to classify the information on the subject into anything like a science. The explanation of this recent advance may be found, first, in the fact that this class of domestic animals supplies human food that is second only in importance and value to dairy products. The egg offers the most digestible form of meat known and one which can be cooked in the greatest number of attractive ways, and the flesh forms an article of diet universally prized for its attractive flavor, which is distinctly different with each kind of poultry. In addition to and perhaps of greater importance than the nutritive value of eggs is the vitamine value which eggs possess in large degree and which are essential to growth. The fact that eggs contain all of the nutritive qualities and also the life-giving vitamine principle complete and in proper proportions to sustain the developing embryo chick makes the egg superior even to milk in sustaining human life. The second reason is found in the fact that poultry, particularly fowls and pigeons, are variable and plastic in the hands of the breeder and can be rapidly and skilfully made to acquire new forms and colors. In no branch of animal husbandry have so striking results been accomplished as in poultry breeding. Observe the large number of varieties at the present time and note the contrast between the mammoth Brahma, weighing 12 pounds, and the diminutive bantam of the same name, weighing 20 ounces; the brilliantly spangled Hamburg and the sombre Orpington; the long tail of the Yokohama and the inconspicuous, cushion tail of the Cochin; the clean, close feathering of the Indian game and the abundant, fluffy feathering of the Asiatics; the smooth shanks of the Plymouth Rock and the feathered shanks of the Langshan; the great prolificacy of the sprightly Leghorn and the large, solid muscle of the unproductive, clumsy Indian Game. Also note the great variety of plumage, both in color, color pattern and form of feather in the different breeds and varieties of the domestic fowl. For example, the spangled, laced, penciled, striped barred pattern and the solid-colored feather, including red, buff, black, white and blue; and in feather forms — ragged in the Frizzles and downy in the Silky; varieties of fowls with eyes varying in color from black to pearl, bay or gray; fowls with rose combs, leaf combs, single or pea combs, spike combs; fowls with or without beards and crests and showing in their plumage every color of the spectrum.

Equal in variability to the domestic fowl is the pigeon with its vastly different types of colors, sizes, shapes and physical characteristics. Then realize that all of these have been produced within the history of man; in the case of the fowl from a single or, at most, a few wild species of jungle fowl, and in the case of pigeons, from the single rock pigeon; moreover, domestic fowls, including several hundred varieties, breed reasonably true.

Poultry Statistics 1910 and 1900 in the United States.— The tables on following page give the number of the various kinds of poultry reported in 1910 and 1900, together with their value, and the number of farms reporting each kind in 1910; the number and value of poultry by States, value of products, etc.

Poultry Statistics 1910 and 1900.

KIND	1910 (April 15)				1900 (June 1)
	Farms reporting		Number of fowls	Value	Number of fowls
	Number	Per cent of all farms			
Total	5,585,012	88.1	295,876,176	$153,394,142	250,623,354
Chickens	5,577,218	88.0	280,340,643	140,192,912	233,566,021
Turkeys	852,679	15.4	3,688,688	6,605,640	6,594,695
Ducks	503,673	7.9	2,904,359	1,566,176	4,785,850
Geese	661,189	10.4	4,431,623	3,192,861	5,676,788
Guinea fowls	339,922	5.4	1,765,033	613,282	(1)
Pigeons	99,409	1.6	2,730,996	762,372	(2)
All other [2]	2,005	(3)	14,834	460,899	(2)

[1] Included with chickens. [2] Not reported. [3] Less than one-tenth of 1 per cent.

The summary on poultry shows that the total number of farms reporting the different kinds in 1910 was 5,585,012, the total number of fowls being 295,876,176, and the total value $153,394,000. Of the total number of farms reporting, nearly all, or 5,577,218, reported chickens, numbering 280,340,643, valued at $140,193,000. The number of farms in the United States reporting poultry increased 489,732, or 9.6 per cent, during the decade. The total number of fowls increased 18.1 per cent, while the relative increase in their value was considerably over four times as great, amounting to 78.9 per cent. The average number of fowls per farm reporting increased from 49 to 53.

Poultry Statistics from the Census Report 1910, United States.

Number Poultry by States.

1.	Iowa	23,482,880
2.	Illinois	21,409,835
3.	Missouri	20,897,208
4.	Ohio	17,342,289
5.	Kansas	15,736,038
6.	Indiana	13,789,109
7.	Texas	13,669,645
8.	Penn	12,782,341
9.	Minnesota	10,697,075
10.	New York	10,678,836

Value Poultry by States.

1.	Iowa	$12,269,881
2.	Missouri	11,870,972
3.	Illinois	11,696,650
4.	Ohio	9,532,672
5.	New York	7,879,388
6.	Indiana	7,762,015
7.	Penn	7,674,387
8.	Kansas	7,377,469
9.	Michigan	5,610,958
10.	Texas	4,806,642

Value Products Sold.

1.	Ohio	$18,362,951
2.	Missouri	18,285,980
3.	Illinois	18,080,352
4.	Iowa	17,594,432
5.	Penn	16,192,756
6.	New York	15,161,114
7.	Indiana	14,635,464
8.	Kansas	11,623,882
9.	Michigan	10,293,428
10.	California	8,736,282

Dozens Eggs Produced.

1.	Missouri	111,816,693
2.	Iowa	109,760,487
3.	Ohio	100,889,599
4.	Illinois	100,119,418
5.	Kansas	81,659,304
6.	Indiana	80,755,427
7.	Texas	77,845,047
8.	Penn	74,729,705
9.	New York	72,349,034
10.	Michigan	59,915,851

Dozens Eggs Sold.

1.	Missouri	71,886,145
2.	Iowa	70,835,349
3.	Ohio	69,575,637
4.	Illinois	62,036,857
5.	Indiana	53,899,416
6.	Kansas	52,833,166
7.	Penn	52,446,077
8.	New York	48,074,481
9.	Michigan	38,568,386
10.	Minnesota	34,347,776

Value Eggs Sold.

1.	Ohio	$13,608,860
2.	Missouri	12,452,508
3.	Iowa	12,387,353
4.	Illinois	11,747,315
5.	Penn	11,560,908
6.	New York	11,394,511
7.	Indiana	10,312,390
8.	Kansas	8,946,839
9.	Michigan	7,547,202
10.	California	6,717,426

Average Value per Dozen.

1.	Dist. of Columbia	$.342
2.	Arizona	.305
3.	Nevada	.304
4.	Massachusetts	.303
5.	Rhode Island	.298
6.	Connecticut	.290
7.	New Hampshire	.277
8.	Montana	.276
9.	Washington	.268
10.	New Jersey	.264

I. American Classes of Poultry.

This class includes six breeds and varieties, as follows:

Plymouth Rocks, six varieties	Barred. White. Buff. Silver Penciled. Partridge. Columbian.
Wyandottes, eight varieties	Silver. Golden. White. Buff. Black. Partridge. Silver Penciled. Columbian.
Javas	Black. Mottled.
Dominiques.	
Rhode Island Reds	Single Comb. Rose Comb.
Buckeyes.	

1. History and Origin.— The oldest varieties in the American class are only about 55 to 60 years old. Youngest only 10 to a dozen years and new ones developing. All are of *mixed* origin. Composite breeds all originating in America.

2. Distinguishing Class Characteristics.— (a) Purpose. General purpose, *meat* and *eggs*, and *exhibition.*

(b) Size and weight. Medium to large.

(c) Type compact, blocky, meaty, symmetrical, graceful.

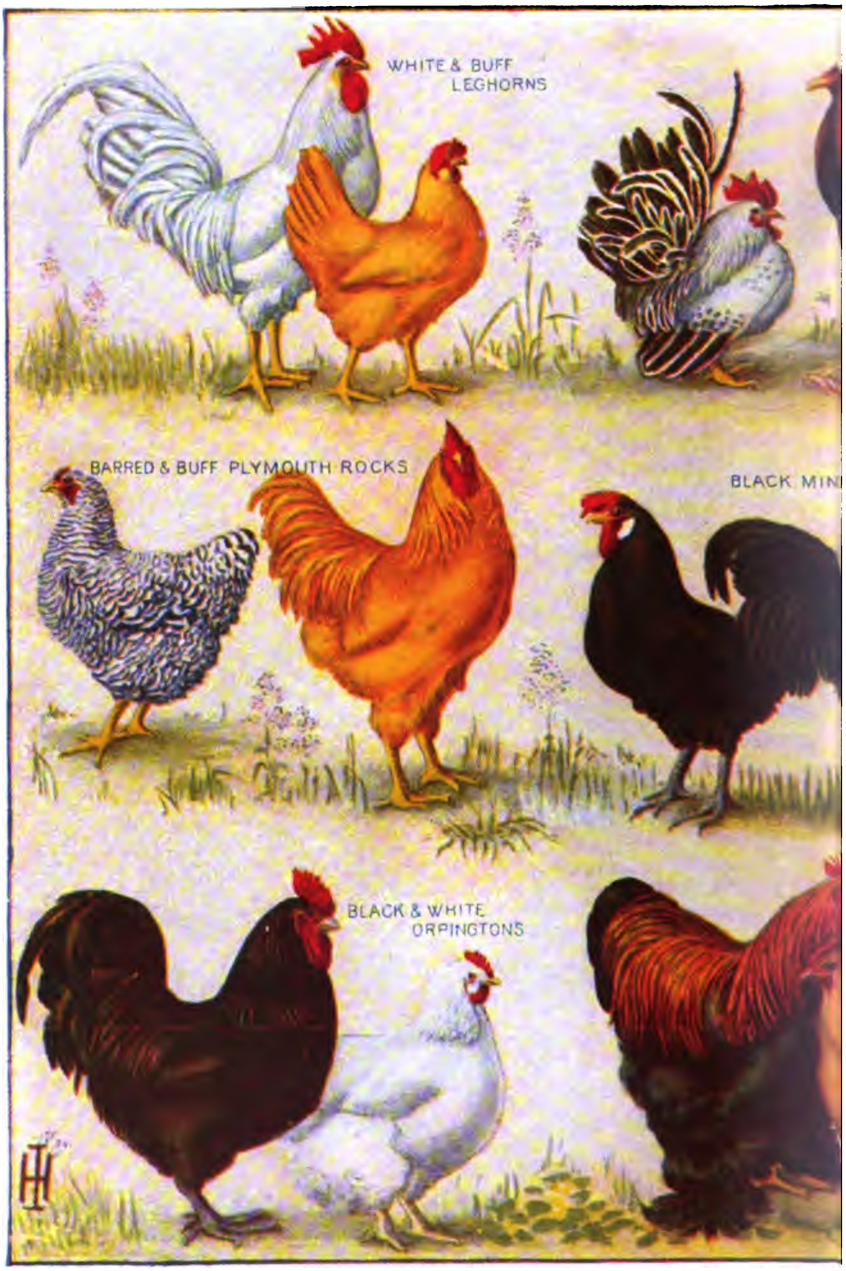
(d) Plumage. Moderate in quantity. Attractive in color patterns and types. Numerous colors to suit the fancy: Barred, Penciled, Laced, Mottled, Stripd, Red, White, Black, Buff.

(e) Skin. Yellow medium to coarse.

(f) Attractiveness. Attractive on account of type, carriage and color variations. «Style Plus.»

(g) Rate of development. Moderately rapid, maturing three to four weeks later than Leghorns under normal conditions, and three to four weeks earlier than Asiastics.

(h) Habits. Non-flying, active, low to medium fences will retain them. Very best of foragers.



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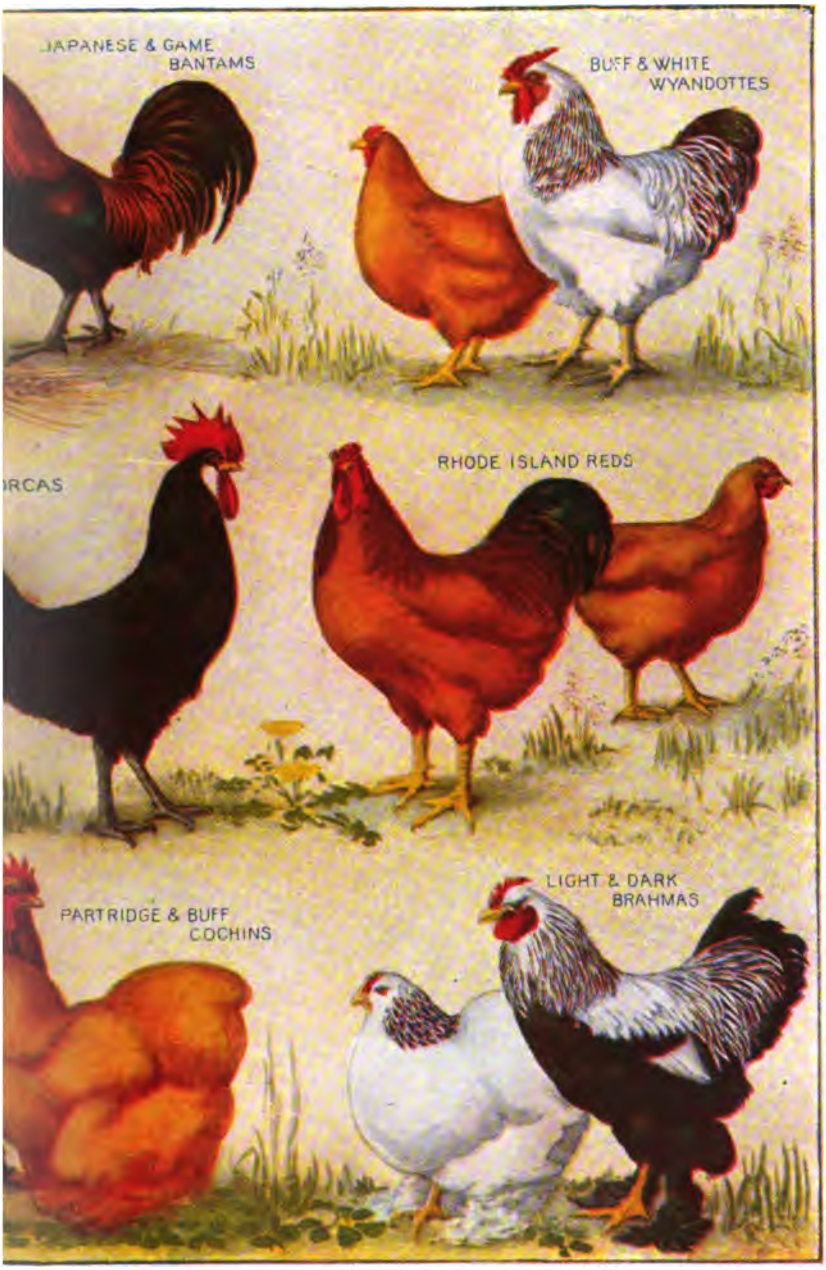
LEADING BREEDS


JAPANESE & GAME
BANTAMS
BUFF & WHITE
WYANDOTTES
RCAS
RHODE ISLAND REDS
PARTRIDGE & BUFF
COCHINS
LIGHT & DARK
BRAHMAS

OF CHICKENS

(i) Temperament. Active, but not sprightly, slow but not sluggish.

(j) Hardiness. Very hardy, small to medium comb and wattles. Well-protected bodies.

(k) Maternal qualities. The very best. Courageous and strong. Brooding instinct largely developed, intelligent, kind disposition, medium size, not clumsy. Occasionally bred small for hatching and brooding wild game birds. Smooth shanks are an advantage in brooding.

(l) Disposition. Kind, somewhat combative, but not vicious.

(m) Prolificacy. Except in some instances. The very best of winter layers. Good all-year-round producers. Superior to Asiatics, but inferior to Mediterraneans.

(n) Eggs. Slightly tinted to very dark brown, mostly lighter tints. Size medium to large. Thick, uniform shells.

(o) Meat production. Excellent. Medium as to quantity and also quality and rapidity of growth. Rocks for large roasters, Wyandottes for broilers or medium to light roasters, and Rhode Island Reds for small to medium roasters.

(p) Breeding efficiency. Most of the breeds are reliable in transmitting their characters, but are not as prepotent as Asiatic or Mediterraneans because a composite group and of more recent origin.

(q) Variable physical characters are: (1) Shanks smooth, yellow except Javas, and responsive; (2) Skin yellow (except Javas); (3) Comb and wattles medium to large; (4) Earlobes red; (5) Molting normal.

II. Asiatic.

This class includes three breeds and eight varieties as follows:

Brahmas	Dark. Light.
Cockins	Buff. Partridge. White. Black.
Langshans	Black. White.

For breeds and varieties consult the 'American Standard.'

1. History and Origin.— These are among the oldest known breeds. None are older except, perhaps, the games. They are of Chinese origin with a parentage too remote to be known. The size of fowl appeared to be a religious requirement in the country of origin. Have exerted the greatest influence of any class of fowl in the formation of new breeds in this country.

2. Distinguishing Class Characteristics.— (a) Purpose. Meat and winter egg production and for exhibition. Poor laying qualities. Among the best for heavy roasters and capons, particularly the Brahmas. Especially desirable for capons, especially for crossing for meat purposes. Rather coarse flesh. For village and general farm rather than large poultry plants, except on roaster farms. (b) Size and weight. The largest and heaviest class, weighing from 11 to 12 pounds for the cock; 7½ to 9½ for the hens.

(c) Type. Rangy, large bone, open organization. The shape of the breeds differs widely. Brahma erect, stately. Cochin squatty. Langshan tall and leggy.

(d) Plumage. Exceedingly heavy. The breeds are *parti-colored* and *solid buff, black* and *white*. The breed of feathers. Withstand cold weather.

(e) Skin. Yellow and coarse.

(f) Attractive because stately and large.

(g) Rate of development slow, late maturing both in growth and in egg production. Have a pronounced lank and bony state in development.

(h) Habits. Non-flyers. Do not scratch. Feet on ground all time. Low fences and small yards are sufficient. Naturally good foragers because not timid.

(i) Temperament. Phlegmatic and inactive. Not easily frightened.

(j) Hardiness. Very hardy naturally except when bred in too close confinement for the fancy. Resistant to unfavorable conditions. Not responsive to disturbing climatic conditions.

(k) Maternal qualities. Brooding instinct largely developed. Persistent sitters. Kind, but clumsy mothers. Because of their large size and abundance of feathers, they can cover many eggs and chickens.

(l) Disposition. Kind. Not quarrelsome or combative.

(m) Prolificacy. Poor producers. A large proportion of eggs in late winter.

(n) Eggs. Medium to large in size, but small in proportion to the size of fowls. Fairly uniform in shape and size. Color, light to very dark brown and fairly uniform.

(o) Breeding efficiency. Prepotent, because characters long established and proven. Mating efficiency low — Brahmas, 1 male to 8–10 females. Langshan, 1 male to 12–15 females. Cochins, 1 male to 6–8 females.

(p) Meat quality. Considered coarse in texture but large in quantity for Brahmas and Langshans but to a less extent of which Cochins are not meaty. Brahmas and Langshans are among the best for meat production of any of the larger breeds. Not equal to Orpington or Dorking, Lafleche or Faverolles, Sussex, but as satisfactory as the American class, as Rocks or Wyandottes and better than the Mediterraneans, such as Leghorns, Anconas, etc., especially satisfactory for "roasters," but not as broilers.

(q) Variable physical characters, as indicating laying condition and productive capacity. Less responsive to feed, fright and temperature: (1) Shanks yellow. Feathered; (2) Skin yellow; (3) Comb, pea comb and single comb, small. Wattles medium in size; (4) Earlobes red; (5) Molting habits similar to other breeds.

III. Mediterranean.

In this class are five breeds and 17 varieties as follows.

Leghorns	Single Comb Brown. Rose Comb Brown. Single Comb White. Rose Comb White. Single Comb Buff. Rose Comb Buff. Single Comb Black. Silver. Red Pyle.

III. MEDITERRANEAN — Continued.

Minorcas	Single Comb Black. Rose Comb Black. Single Comb White. Rose Comb White. Single Comb Buff.
Spanish	White Faced Black
Blue Andalusians.	
Anconas	Single Comb. Rose Comb.

1. **Origin and History.**— Next to the Americans they are the most popular breeds. All from Italy and Spain or in the neighborhood of the Mediterranean.

2. **Distinguishing Characteristics.**—Active, non-broody, prolific.

(a) Purpose. Special egg breeds.

(b) Size and weight. Generally light to medium except Minorcas, which are heavy.

(c) Type. Well-balanced proportions. Small boned, compact.

(d) Plumage. Light and close feathered, in many colors, white, buff, brown, red, pyle and black, in the native country; black predominating: mostly solid colors, mottled, penciled, striped.

(e) Skin. Fine in texture. Yellow except Minorcas and Spanish.

(f) Attractiveness. Graceful, sprightly, head points and plumage especially artistic.

(g) Rate of development. Rapid in both growth and reproduction, except Minorcas, which are like the breeds of the American class.

(h) Habits. Flyers. Only fair foragers because timid. Especially active and industrious in scratching and foraging. Exceedingly *active* in hunting for food but timid in foraging long distances.

(i) Temperament. Alert, nervous, flighty, quick acting; that is, easily frightened.

(j) Hardiness. Very adaptable to wide extremes but more suited to mild climates. Suffer from frozen head appendages, comb and wattles. Very responsive and sensitive to changes in climatic conditions, hence variable in production and physical characters due to environment.

(k) Maternal qualities. Unreliable, largely non-broody, except occasional individuals. Occasional individuals fairly satisfactory for brooding pheasants. Only about 5 to 10 per cent broodiness per year. Require artificial incubation and brooding. Kind but fickle and fussy as mothers.

(l) Intelligence. Especially intelligent, in learning to eat and return to hover when young.

(m) Disposition. Courageous, strong in defense but not quarrelsome.

(n) Prolificacy. The very highest in fecundity. Exceedingly precocious. The first eggs laid when four and one-half to five and one-half or six months.

(o) Economical production. Economical production is their strongest point as layers. Cost of production among the least per dozen, or per pound of eggs, due to small size of body.

(p) Feeding advantages. Easy to feed; not as likely to get too fat as heavier, less active breeds. (Except Minorcas).

(q) Egg quality. Eggs are medium to large. All white with but slight tendency to tintedness. Uniform in shape.

(r) Meat qualities. Generally too small. Lack economical dressing quality. Unsatisfactory except for squab broilers, at three-fourths of a pound to one and one-fourth pounds. Flesh fine grained. Large proportion of breast meat. The muscles used in flight.

(s) Breeding efficiency. Prepotent. A dominant race well established. Run out other less prepotent races. Mating qualities one to 25 or 40 hens. Mate most freely of any classes. Highest fertility and hatching power.

Variable physical characters. Most variable and hence most expressive of laying performance. (1) Shanks smooth, non-feathered and yellow (except Minorcas and the Mottled Anconas), and of great value in judging birds for quality of egg production; (2) Skin yellow, soft and fine; (3) Comb and wattles medium to large; (4) Earlobes white and very responsive to change in color pigmentation; (5) Molting quick and regular.

IV. ENGLISH CLASS.

This class includes (1) White, Silver and Gray and Golden Duckwing; (2) Redcaps; (3) Orpingtons, Single Comb Buff, Black, White and Blue; (4) Cornish, Dark, White and White Laced Red; (5) Sussex, Speckled and Red. The English class are, for the most part, developed along meat-producing lines, although the general purpose idea of combining egg production has been attempted. The Orpingtons, the Cornish and the Sussex have been developed particularly for meat type which has materially decreased egg production qualities. They form the basis, however, of some of the most desirable of our varieties for the production of high quality meat.

V. POLISH CLASS.

This family consists of one breed having eight varieties; namely, White-Crested Black, Golden, Silver, White, Bearded Golden, Bearded Silver, Bearded White and Buff Laced. They are medium in size, good layers of white eggs and non-sitters. All have large, showy crests owing to which they fall easy victims to hawks and enemies. They have, in some cases, beards; small V-shaped combs and slate and willow shanks. As they are chiefly ornamental they are not popular in the United States.

VI. HAMBURGS.

This is a Dutch family consisting of one breed and six varieties. Golden Spangled, Silver Spangled, Golden, Silver and White Penciled and Black. They are unsatisfactory for meat and generally considered too small for popular use for egg production.

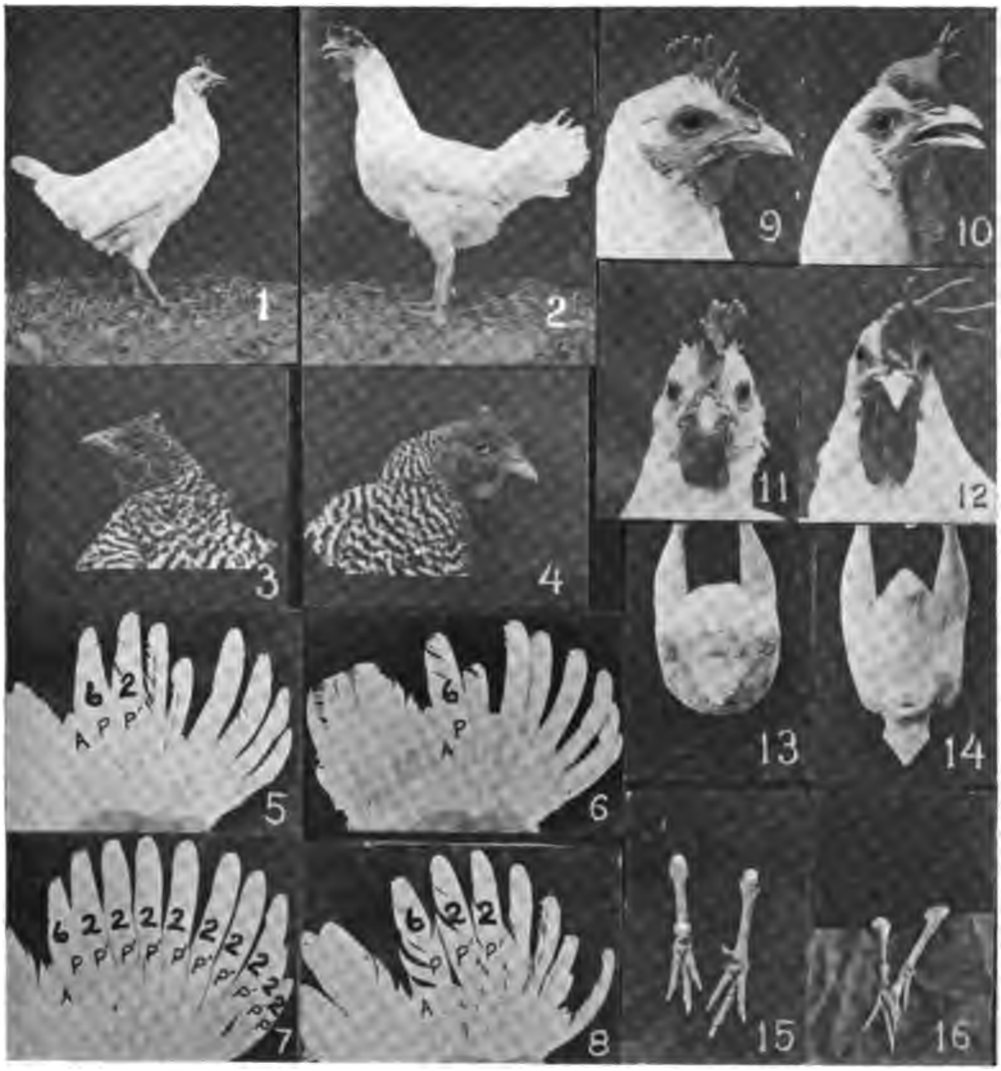
VII. FRENCH.

This class consists of four breeds and five varieties. (1) Houdans, White and Mottled; (2) Crevecours, Black; (3) La Fleche, White; (4) Faverolles, Salmon. All of these varieties are distinctly of the meat-producing type, although bred as general purpose fowls having fairly satisfactory egg-producing qualities.

VIII. CONTINENTALS.

This class consists of Silver and Golden Campines. They are Belgian in origin and are of small size, distinctly of the egglaying type, very prolific and extremely hardy.

POULTRY



1 A POOR LAYER — (a) Yellow color of head, shanks and plumage. (b) New plumage. (c) Small, hard, dried, scale-covered comb. (d) Wrinkled ear lobes. (e) Tucked up abdomen. (f) Full face

2 A GOOD LAYER — (a) Pale color of beak, eye-ring, ear lobes, face, shanks. (b) Old, unmolted, ragged plumage. (c) Full, bright, waxy comb. (d) Full ear lobes. (e) Deep abdomen. (f) Intelligent head

3 and 4 HEAD PARTS — 3 (a) Wrinkled ear lobe. (b) Full face. (c) Face, eye-ring and beak yellow. 4 (a) Full ear lobe. (b) Thin face. (c) Pale color of beak, eye-ring and face

5 and 6 EGG PRODUCTION INDICATED BY THE LENGTH OF TIME OF MOLTING AS DETERMINED BY THE SHEDDING OF THE PRIMARY FEATHERS — It takes about six weeks to completely renew the primary feather (P) next to the axial feather (A) and an additional two weeks for each subsequent primary feather (P). (Photographs taken on 4 December). 5 AN EIGHT-WEEK MOLT (Two feathers completely renewed) — Estimated date stopped laying 9 October. Second year record 164 eggs. 6 A SIX-WEEK MOLT (Primary feather next to axial feather renewed) — Estimated date stopped laying 23 October. Second year record 186 eggs

7 A TWENTY-FOUR WEEK MOLT (Ten feathers completely renewed) — Estimated date stopped laying 21 June. Second year record 75 eggs

8 A TEN-WEEK MOLT (Three feathers completely renewed) — Estimated date stopped laying 25 September. Second year record 121 eggs

9 and 10 HEAD PARTS — 9 LOW PRODUCER (not laying) — (a) Small, hard, dried, scale-covered comb and wattles. (b) Fat face. (c) Yellow color of beak, eye-ring, ear lobes, face. (d) Wrinkled, shrunken ear lobe. (e) Dull, snaky eye. 10 HIGH PRODUCER (full laying) — (a) Full, bright, stiff, waxy comb and wattles. (b) Thin face. (c) Pale color of beak, eye-ring, ear lobes, face. (d) Full ear lobe. (e) Bright, round eye

11 and 12 HEAD PARTS — Same as above

13 POOR LAYERS (in non-laying condition) — (a) Vent yellow, small, hard and puckered. (b) Distance between blunt pelvic bones short. (c) Body full, hard and plump

14 GOOD LAYERS (in laying condition) — (a) Vent pale, large, full and moist. (b) Pelvic bones wide-spread. (c) Skin soft and flabby

15 and 16 SHANKS — 15. (a) Shanks yellow. (b) Shanks full, hard, round in the back. 16. (a) Shanks pale. (b) Shanks thin, and soft in the back

IX. Games and Game Bantams.

This class consists of 16 varieties, eight of which are Black Breasted, Red, Brow-Red, Golden Duckwing, Silver Duckwing, Birchen, Red Pyle, White and Black, and eight varieties of bantams, minatures of the above. Their purpose is primarily for exhibition and fighting.

X. Orientals.

The Orientals are Sumatras, Black Malay, Black-Breasted Red Malay Bantams, Black-Breasted Red. The class is primarily kept for exhibition purposes.

XI. Ornamental Bantams.

The Ornamental bantam class consists of (1) Golden and Silver Sebright; (2) White and Black Rose Comb; White Booted; Light and Dark Brahmas; Buff, Partridge, White and Black Cochins; Black Tailed, White, Black and Gray, Japanese Bearded, White, Buff Laced, Non-Bearded Polish and Millefleur (booted).

XII. Miscellaneous.

The miscellaneous class consists of the Silkys, Sultans and Frizzles which are produced as oddities and primarily for ornamental purposes and for exhibition.

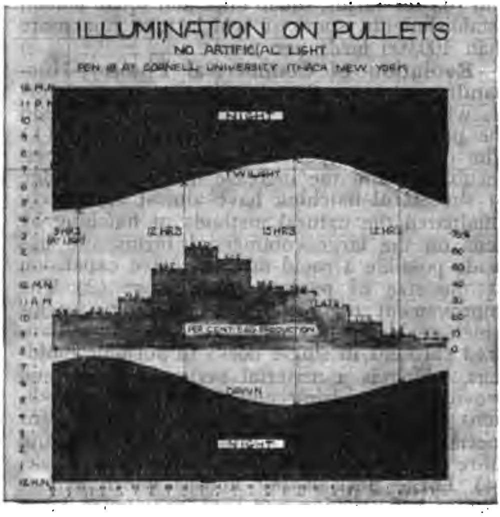
Education and Research in Poultry Husbandry.— Among the 62 State agricultural colleges and experiment stations in the United States, only 10 offered courses of instruction in poultry husbandry in any form in 1904, whereas now nearly every State in the Union offers instruction in some form in poultry husbandry. To Cornell University is due the credit of having given the first regular course of instruction in poultry husbandry in the United States, which occurred in the winter of 1891 at Ithaca, N. Y. The first specialized short course where the students devote all of their time to poultry instruction occurred at Kingston, R. I., in 1898, at which time a six-weeks' poultry course was given. The first poultry investigational work in the United States devoted to poultry was at the Maine Experiment Station, Orono, Me., in 1885. In New York State, at the New York State agricultural experiment stations at Geneva, N. Y., and at Cornell University, experimental work with poultry was conducted in 1889 and 1890, respectively. At the present time practically every State in the Union provides facilities for experimental work in this subject and many States have made as large or larger provision for research work in poultry husbandry as for any branch of agriculture.

More than 75 poultry and pigeon papers are published in the United States alone, several of which report circulations of from 30,000 to 60,000 copies to each issue. In addition to this nearly all agricultural and livestock papers conduct poultry departments. In order to hatch the billions of chickens produced each year more than 50 kinds of incubators are manufactured in the United States, which leads all nations in this field of inventive skill. In 1890 a 500-hen poultry farm was an object of wonder, but now there are thousands of poultry plants having 2,000 hens and many which have from 5,000 to 10,000 or more, besides broiler and roaster farms, squab duck and squab pigeon establishments, some of which turn out more than 100,000 birds per year.

Evolution of Commercial Poultry Husbandry.—Among the more important discoveries which have had a profound influence upon the poultry industry may be mentioned: (1) The development of efficient hatching devices. Incubators and the increase in our knowledge of successful hatching have almost completely eliminated the natural methods of hatching by hens on the large commercial farms and has made possible a rapid and extensive expansion of the size of poultry enterprises; (2) The improvement of large flock-brooding systems which enables poultrymen to brood several hundred chickens in single flocks in portable buildings, which is a material saving in labor and provides for rearing under free range conditions; (3) Standardized methods of feeding for special purposes which results in larger and more economical production of healthier stock; (4) Large flock laying houses which reduce cost of construction per bird, economize labor and provide greater comfort, reduce mortality and increase production; (5) Improvement in the breeds as a result of discovery of methods of judging fowls for production by means of external characters and the perfection of methods of marking poultry for future identification, the use of trap nests and pedigree hatching trays which enables the breeder to connect up the performance of the progeny with that of the parents, has resulted in greater progress being made in efficient production in the past generation than in the preceding century; (6) The use of artificial light in the control of egg production is one of the most important discoveries in the efficient management of poultry. By our knowledge of this factor in the economical production of eggs it is now possible to materially increase the proportion of eggs that are normally laid in periods of scarcity and high prices in the fall and winter months in the north temperate climate and to do so without proportionately decreasing the normal production during the remainder of the year. The influence is far reaching in its effect upon the poultry industry due to the fact that by the control of production by means of artificial light, the poultryman increases the production of eggs laid during periods of high prices and reduces the cost of production without injury to the fowls.

Some of the more important variable physical characters used in determining the laying quality of fowls are shown in accompanying plate and explained in the descriptive statement of method of judging fowls for egg production, prepared at the Judging School, State College of Agriculture, Cornell University, and approved by the American Association of Instructors and Investigators in Poultry Husbandry.

Method of Judging Fowls for Egg Production.— In order to lay well a bird must have a sound body. As a first consideration a bird must be *vigorous and healthy* if it is to be able to lay well. Vigor and health are shown by a bright, clear eye, a well-set body, a comparatively active disposition and a good circulation. Further, the bird must be free from *physical*



FIG, 1.—This graph shows the length of the light and the darkness each month of the year from 28 Nov. to 31 Oct. and the distribution of egg production each month stated in percentage. It will be seen that there is a very marked relationship between the egg production each period and the length of the day. It will be seen that on the 21st of Dec. in New York State the nights are approximately 15 hours long and the days 9 hours long, whereas on 21 March and 21 Sept. the nights and the days are equal and that on 21 June the nights are only 9 hours and the days 15 hours long. It has been found that the digestive system of the fowl has a capacity of about 12 hours between feedings and hence they cannot produce efficiently when the time between meals is more than 12 hours long. Under the normal day light conditions it will be seen that the largest production is in the months of April, May and June when eggs are cheapest, and least in October, November and December when eggs are highest.

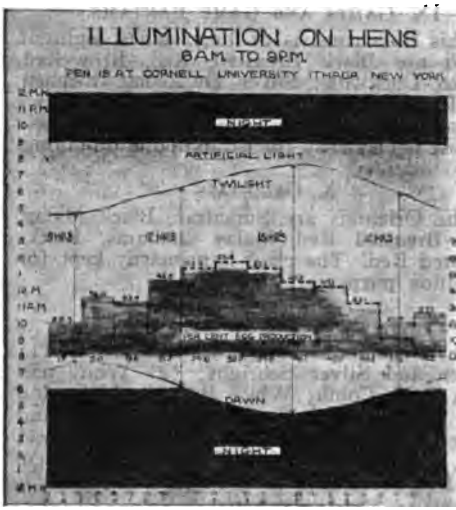


FIG. 2 shows the change in egg production brought about by the use of artificial light from 6 A.M. to dawn and from twilight to 9 P.M. The dotted line plots the curve of production shown in Fig. 1. and which shows in Fig. 2 that a large increase in production was secured in periods of highest prices and with only slight reduction in production in periods of lowest prices, leaving a net gain of more eggs per year and a larger production of high priced eggs without injury to the hens.

defects such as crooked beak, excessively long toe nails, eyelids that over-hang so that the bird cannot see well, scaly leg or anything else that would keep the bird from seeing or getting an abundance of food.

Loss of Fat Due to Laying.—Color or pigmentation changes. (These should be observed by daylight). A laying fowl uses up the surplus fat in the body, especially it removes the fat from the skin. In yellow-skinned breeds this loss of fat can readily be seen by the loss of the yellow color. The different parts of the body tend to become white according to the amount of fat stored in the body and the amount of circulation of blood through that part. The changes occur in the following order: The *vent* changes very quickly with egg production so that a white or pink vent on a yellow-skinned bird generally means that the bird is laying, while a yellow vent means a bird is not laying. It should be recognized that all yellow color changes are dependent on the feed, coarseness of skin and size of bird. A heavy bird fed on an abundance of green feed or other material that will color the fat deep yellow will not bleach out nearly as quickly as a smaller or paler colored bird. The *eyering*, that is, the inner edges of the eyelids, bleach out a trifle slower than the vent. The earlobes on Leghorns and Anconas bleach out a little slower than the eyering, so that a bleached earlobe means a little longer or greater production than bleached vent or eyelid. The color goes out of the *beak* beginning at the base and gradually disappears until it finally leaves the front part of the upper beak. The lower beak bleaches faster than the upper, but may be used where the upper is obscured by horn or black. On the average colored, yellow-skinned bird a bleached beak means heavy production for at least the past four to six weeks. The *shanks* are the slowest to bleach out and hence indicate a much longer period of production than the other parts. The yellow goes out from the scales on the front of the shanks first and finally from the scales on the rear. The scales on the heel of the shank are the last to bleach out and may generally be used as an index as to the natural depth of yellow color of the bird. A bleached-out shank usually indicates fairly heavy production for at least 15 to 20 weeks.

The yellow color comes back into the vent, eyering, earlobes, beak and shanks in the same order that it went out, only the color returns much more quickly than it goes out. A vacation or rest period can sometimes be determined by the outer end of the beak being bleached and the base being yellow.

Body Changes Due to Laying.—A laying hen has a large, moist *vent* showing a dilated condition and looseness as compared with the hard, puckered vent of a non-laying hen. The whole *abdomen* is dilated as well as the vent so that the pelvic arches are widespread and the keel is forced down, away from the pelvic arches so as to give large *capacity*. The more eggs a bird is going to lay the following week the greater will be the size of the abdomen. The actual size of the abdomen is, of course, influenced by the size of eggs laid and by the size of the bird. Heavy production is shown by the quality of the skin and the thickness and stiffness of the *pelvic arches*. Fat goes out from the skin and body with production so that the heavy producers have a soft velvety skin that is not underlaid by layers of hard fat. The abdomen in particular is soft and pliable. The *sternal processes* are very prominent and are generally bent outward. The thicker and blunter the pelvic arches and the greater the amount of hard fat in the abdomen the less the production or the longer the time since production. One of the finer indications, but yet one of the most valuable in picking the high layer, is the fineness of the head and the closeness and dryness of *feathering*. The head of a high layer is fine. The wattles and earlobes fit close to the beak and are not loose and flabby. The face is clean-cut. The eye is full, round and prominent, especially when seen from the front. The high layer is trimmer, that is, the feathers lie closer to the body and after heavy production the oil does not keep the plumage relatively as sleek and glossy, but the plumage becomes worn and threadbare.

Changes in Secondary Sexual Characters. — *The Comb.* Wattles and earlobes enlarge or contract, depending on the ovary. If the comb, wattles and earlobes are large, full and smooth or hard and waxy, the bird is laying heavily. If the comb is limp the bird is only laying slightly, but is not laying at all when the comb is dried down, especially at molting time. If the comb is warm it is an indication that the bird is coming back into production.

Molting.— When a bird stops laying in the summer she usually starts molting. The later a hen lays in the summer or the longer the period over which she lays the greater will be her production, so that the high producer is the late layer and hence the late molter. The length of time that a hen has been molting or has stopped laying can be determined by the molting of the primary feathers. It takes about six weeks to completely renew the primary feathers next to the axial feathers and an additional two weeks for each subsequent primary to be renewed.

Temperament and Activity.— A good layer is more active and nervous and yet more easily handled than a poor layer. A high layer shows more friendliness and yet elusiveness than a poor bird. A low producer is shy and stays on the edge of the flock and will squawk when caught. While the characters discussed have dealt specifically with the current year's production, it should be borne in mind that a high producer one year is, generally speaking, a high producer in all other years.

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POULTRY AS AN INDUSTRY. The information of the present article will be given under the following divisions: (1) The demand; (2) conditions of success; (3) details to be observed; (4) the necessary equipment; (5) the profit of the industry.

THE DEMAND.

There is a steady and constantly increasing demand for first-class poultry products, both in the form of eggs and poultry for the table and when the production of either of these commodities is combined with bure-bred poultry the producer has a doubly assured and considerably increased income.

There is certainly no danger of over-stocking the market, provided the quality be first-class. Statistics prove that the city of Greater New York consumes more eggs each year than the entire Empire State produces. The two States of New York and Pennsylvania consume five times as many eggs as they produce. The importation of poultry into these two States is even proportionately larger than that of eggs. The people who produce the choicest poultry for the tables of the more fastidious residents of our great Eastern cities realize prices more than double the average price of the average poultry products marketed in those same cities. The retail price of strictly first-class eggs during the fall and winter months is more than three times the average summer price of average eggs in those same markets. There is a constant demand at these high prices for a product that can be guaranteed strictly first class, while it is only the second-class or third-class products that are at any time a drug on the market. The people are being educated to the fact that there is a vast difference between fowls of the same age for table purposes, and that even fowls of the same variety and age vary largely in quality according to the methods by which they have been fatted and dressed.

CONDITIONS OF SUCCESS.

There are a few general principles, therefore, that he who hopes to succeed in the poultry business should become familiar with before embarking largely in this enterprise. 1. He must ever bear in mind that to acquire the greatest profit he must produce the finest quality. The market is generally glutted with the lower grades of poultry and eggs. These are supplied at an actual loss. 2. He must decide upon some one branch of the business which he will make his specialty, and, having made his decision, he must push that line to the limit, cultivating only as accessory the other minor branches of the industry. In making this decision he must give careful attention to his own adaptability to his chosen branch of the work, considering well his location and surroundings, his proximity to market and the demands of that market. 3. He must be prepared to apply the business principles of the business man to the poultry industry. He must apply the principles of industry, thrift and economy in poultry production with the same energy and persistence as they are practised in our great manufactories. In fact, he becomes a manufacturer, converting the raw materials of the farm crops into those finely finished products, eggs and poultry.

DETAILS TO BE OBSERVED.

Having decided, for example, that egg production for the city markets shall be his chief aim, he must proceed in building up his business with that particular object constantly in view. In this work the following hints will be useful:

1. **Selection of His Variety.**— He must keep but one variety, so that his eggs may be as nearly uniform in color and size as possible. Boston calls for a brown egg; New York prefers a white egg. Each city will pay a few cents per dozen more for eggs of its favorite color. The Asiatics — Brahmas and Cochins — and the Americans — Plymouth Rocks and Wyandottes — produce the brown eggs. The Mediterranean varieties — Leghorns, Minorcas and Anconas — are the largest producers of the white eggs.

He must, however, in selecting his variety, remember that the Brahmas and Cochins will produce but few eggs until eight months old, while the Plymouth Rocks will lay at six months, and the Wyandottes and Leghorns at five months.

If he intends to grow his own young stock he must provide incubators and brooders for the non-sitting Mediterranean varieties, while the Asiatic and American varieties will hatch and rear their own young.

He must also calculate on building warmer and more comfortable houses for the Mediterraneans than will be necessary for the close-fitting rose-combs of the Wyandottes or the small pea-combs of most of the Asiatics. All the Mediterranean varieties have large combs and pendulous wattles, very susceptible to frost. The Plymouth Rocks, with their medium-sized combs, come between the extremes described, in this particular.

The time of year when he stocks his plant will decide whether he shall start by purchasing eggs for hatching or shall purchase fowls for his foundation. If he begins in the spring, and is equipped with incubators for hatching — and few now depend exclusively on the hens for hatching and rearing — then he will start more cheaply by purchasing eggs from some reliable breeder of his chosen variety. In the fall of the year it is best to start by buying pullets then four to six months old and ready to begin producing eggs.

2. **Care of the Stock.**— No hen can be a profitable egg producer unless she is kept comfortable and happy. More poultry plants have been wrecked and abandoned because of neglect in caring for the fowls than by any other cause. The questions of food and shelter will be considered under those headings, so we shall content ourselves here with merely mentioning two items:

(a) **Cleanliness.**— The hen is not an exacting tenant but she is naturally rather fastidious about some things, and she has a right to be. She must have her bath, and that bath is not a water bath, but a dust bath in which she can wallow occasionally and sift her feathers full of fine dust. This looks to be dirty, but it is not; simply dusty. Her quarters, furthermore, must be frequently cleansed. All droppings should be removed from the dropping-board at least once each week, and a little sweetening of the surroundings by a liquid disinfectant and insecticide is most advisable. Fresh straw as a litter for the floor of the house should be provided occasionally, and the nests — the receptacles for those fresh eggs so susceptible to any taint — should be renewed with fresh material frequently.

(b) **Water.**— Since an egg is two-thirds water, it seems useless to argue for a constant supply of pure, fresh water. If this is provided, a hen will drink 20 times a day. If it is not supplied, her natural thirst will compel her to drink from filthy pools wherever she can find them, even from the cow tracks in the mud of the barnyard. Is it strange that fastidious people are becoming so particular as to specify how the hens that produce their eggs shall be supplied with food and water?

3. **The Separation of the Sexes.**— This subject is attracting much attention of late, and properly. So soon as the cockerels can be determined from the pullets they should be separated. Both sexes develop much more satisfactorily when kept by themselves. The cocks should be removed from the yards at the close of the breeding season, say in June, not to return until January or February. This much for the best interests of the fowls themselves.

But it is for a better and more certain quality of the eggs that we urge a separation of the sexes. When a hen that has been mated produces an egg, that egg has been fertilized at a certain point in its passage down the oviduct. From the moment of said fertilization until it is deposited in the nest — under normal conditions about 12 hours — the heat of the hen's body has caused the process of incubation to progress. If some great excitement prevents the hen from depositing the egg until the next day, the egg shows bloody streaks. We have known eggs to be thus retained by the hen for 60 hours, so that at the time the egg was laid the heart beats of the embryo chick could be seen with the naked eye.

While the process of incubation practically ceases as soon as the freshly-laid egg reaches a temperature as low as 80°, yet succeeding hens coming on the nest, perhaps several of them the same day, each warm that fertile egg up above 90° and the process of incubation is resumed. Where eggs are gathered at irregular periods — too often only «every few days» — it can readily be seen that only absolutely infertile eggs, those laid by unmated hens, are safely fresh, and many institutions, and even private families, are now making their contracts for «virgin eggs.»

On the other hand, eggs that are absolutely infertile may be kept in almost any temperature without spoiling. We have placed such eggs in an incubator and kept them there for three weeks at a temperature above 100° all the time, and at the end of that period amateurs could not distinguish them from fresh eggs. Only the infertile egg will bear transportation in warm weather, and only those who will take care to have such can hope to realize the highest prices.

4. **Poultry Diseases.**— This subject is now very properly attracting much attention in our agricultural colleges. All desire to be excused from eating the eggs of a diseased hen. One's comfort comes, however, in the fact that diseased hens do not lay many eggs. There is a further satisfaction in the knowledge that the much-talked-of fowl cholera is a rare disease. Only a very few well-authenticated outbreaks of this disease have occurred in this country. There are a few other diseases with somewhat similar symptoms that are frequently mistaken for cholera.

(a) **Diarrhœa and Dysentery.**— These diseases are both usually brought on by neglect in the matter of food and drink. Pure water is one of the first essentials, and the fowls usually having an unnatural thirst, the pure water is an easy medium for administering some of the simple remedies, such as the Douglass mixture or a little carbolic acid in the water. With brooder chicks many of these irregularities of the bowels are caused solely by extremes of heat and cold. Chicks under three weeks old will scarcely endure day and night extremes of more than 15 or 20 degrees without manifesting bowel trouble, however carefully they may be fed. With mature fowls in confinement, a failure on the part of the attendant to provide them with grit, gravel, oyster-shell and broken bone is a fruitful cause of these two diseases. Sour and rancid food will also cause diarrhœa, while fowls nearby fed on sound grains will be free from it.

(b) **Roup.**— This is by far the most common disease to which our domestic fowls are subject. It is generally considered contagious, but the most careful experimenters have failed to identify the germ or to inoculate a well fowl from a diseased one. Still we advise caution, and recommend that affected birds be isolated. Roup being simply an aggravated cold which rapidly takes on the catarrhal form, prevention is most advisable. Under buildings we shall urge freedom from draughts and dampness, which are the most prolific causes. The bird taken in the early stages, kept warm and dry, fed liberally, and the throat and nasal passages sprayed with a weak solution of carbolic acid or an emulsion of unrefined petroleum, will generally recover. If he gets seriously ill, kill and bury him.

5. **The Kinds of Food.**— This is a subject on which volumes could be written. In brief, since analyses show that the egg and the body of the young bird are almost identical, we may conclude that the food that is best for egg production is almost the best also for the growing fowl. When the fowl is grown and is about ready to be fatted for market, then a different ration is best, as will be shown.

For either the growing chick or the egg-producing hen, in addition to the grits, bone and shell already referred to, the best results are obtained by a liberal supply, in large variety of form, of the three following classifications of food:

(a) **The Grains.**— These are the natural food of our domestic fowls. They grow in such a variety in this country that there is no excuse for limiting our fowls to a scanty variety. Many erroneously suppose that what a hen picks up first is best for her. Throw down a few handfuls of corn, wheat, oats and millet to a bunch of fowls and the corn will be taken first, the others in the order named. Notice that this is in the order of the size, instinct teaching them to take first that of which they can get the most in the shortest time. Now the corn is the grain that ordinarily should be fed the most sparingly. It is so rich in the carbonaceous, or fat-making, elements that it is neither a good egg-maker or a good flesh-producer. To feed to fowls thin in flesh or to feed on a very cold evening, to enable the fowls to keep up their temperature through a long night, corn is best.

Of all our grains we esteem oats the best. Fowls do not take so kindly to oats as to wheat which we rank as second. Use these two grains alternately. Do not mix your grains. Give them something different each time if possible. Kaffir corn is one of our very best poultry foods. Sorghum seed and broom-corn seed are very similar. Buckwheat and sunflower seed in moderate quantities are excellent. Never feed more grain than they will clean up in a few minutes, unless you bury it among the litter so that they must scratch and work for it. Better that your fowls be kept slightly hungry and in working condition than too fat.

There is not so much necessity for soft foods as most people imagine. With plenty of grit to do the grinding, fowls will do well a longer time on the grains fed whole than on any other rations. There are, however, two forms of the grains that are urged to be used freely, namely, common coarse bran constantly in boxes, dry, where the fowls, young and old, can get all they will eat of it, and ground oats. This last should be fed mixed with bran for the middle-of-the-day feed — the only time that it is advisable to feed soft, wet food.

(b) **The Greens.**— The hen at liberty, or in a state of nature, in summer consumes a large quantity of green, succulent food — clover, white clover, alfalfa, lawn-grass, plantain and a score of other forms of greenness will be found in her full crop as she comes up to the perch at night. On such a ration, together with the grains she picks up, she does her best at the egg-basket, or puts on good flesh the most rapidly. This should teach us, therefore, what to supply her in the cold weather if we wish her to do then the work of summer. We must supply these green things to her. Cabbages and mangel wurtzels, one each hung in her pen, are good. Clover and alfalfa, harvested before the stalks have become woody, cut into short lengths, steamed or wet with hot water, and then dried out in part with the bran or chopped oats — this is the most dependable of all green foods in winter.

(c) **The Meats.**—"As full as an egg is of meat" is an old-time proverb. The white of an egg is largely albumen, and this is best supplied to the laying hen in some form of meat. The hen at liberty gets many a bug and worm. The hen in confinement must have these supplied if she is to produce eggs. The growing and fattening fowl also needs the meat in some form.

Avoid as far as possible the meat-meals of the trade, of uncertain origin and quite likely to be adulterated. Use the coarse granulated beef-scraps whose contents can generally be discovered. These, having been prepared by steam cooking, keep well in any climate. Add to these an abundant supply of clean-cut bone and the combination is cheaper, richer and better than even the ground bone obtained by grinding fresh bones secured from the butcher.

(d) **Fattening Fowls.**— Where it is desired to quickly finish either young or old birds for the market, the crate-fattening process has no equal. Two birds are confined to a slatted coop two feet each way, and, for convenience in handling the droppings, the bottoms are slatted also. The most successful food is some skim milk or buttermilk, thickened to the consistency of batter with finely ground and sifted oats. Feed in a small trough in front of the coop all the birds will consume in 20 minutes, then remove the trough, returning it clean for the next feeding. Some give an occasional feed of grit and cut bone with advantage. Three weeks is as long as birds can be fed by this method; in that time many will gain 40 per cent, some 50 per cent. The improvement in the quality of the flesh is as noticeable as is the increase in quantity. To advance a cockerel weighing three and one-half pounds and worth 10 cents per pound, to one weighing five pounds, worth 15 cents per pound, in three weeks, at a food cost of eight cents, is to almost double one's investment, and many are doing this very thing. The yellow-skinned bird takes on a quality of flesh well distributed and having the white skin and white flesh so much desired by epicures.

RATION FOR FATTENING POULTRY.

The following fattening rations are recommended by the Cornell Department of Poultry Husbandry:

Ration with Milk.— 50 pounds corn meal; 20 pounds white wheat middlings; 10 pounds ground heavy oats. Mixed to a batter fresh at each feeding with buttermilk or skim milk. Will require approximately 1 quart (2 pounds) milk to 1 quart (1 pound) feed.

Ration with Meat Scrap.— 50 pounds corn meal; 20 pounds white wheat middlings; 10 pounds ground heavy oats; 20 pounds meat scrap. Mixed to a batter fresh at each feeding with water. Will require approximately 1½ quarts (3 pounds) water to 2 quarts (2 pounds) feed.

Methods and Practice.— *The Stock:* Rations recommended for both young and old stock. Birds “off condition” or of low vitality cannot be profitably fattened. Before putting in crates grease for lice below vent and under wings with equal parts of vaseline and “one-third strength blue ointment.” *The quarters* must be clean. Mite-free quarters are necessary to ensure keen appetites — the keynote of successful fattening.

Crate Fattening.— Construct the crates 36 inches by 20 inches high of slats, using false bottoms of one-inch mesh wire poultry netting and suspend trough outside. The capacity of this crate is 6 to 8 fowls or 10 to 12 broilers, determined by the number that can eat from trough at once. Locate crates in comfortable temperature — outside in shade or open shed for summer use and in reasonably warm house for fall and winter.

Pen Fattening.— For best results limit flock to 20 or 30 birds, allowing two square feet of floor space per bird. To prevent dirt and waste feed in troughs so built that the birds cannot walk in them. The milk ration is to be preferred where milk is available or can be bought at a price not to exceed 45 cents per 40-quart can (55 cents per hundred weight). Feed all they will clean up readily twice daily for about two weeks, which is usually as long as fowls will “stand up” under such heavy feeding. Broilers may be held longer, especially in the case of pen-fattening, when they should be fed grain in the litter at noon. Birds should not be fed for the first 24 hours so they will eat the new ration greedily. Omit one feeding if at any time birds go “off feed”; clean pails and troughs will help to avoid this. Grit, shell, green feed and water are unnecessary except in hot weather when milk or water may be given at noon.

(e) **The Secret of Successful Feeding.**— To put it in a word, it is variety. Whether feeding for eggs or for growth, your aim must be to have the fowl consume and assimilate the largest possible quantity of food and then convert and manufacture this into eggs or flesh. With the hen as with the dairy cow, the individual with the best digestive apparatus is the one you can feed most profitably, and you must constantly cater to her appetite; when she gets tired of one thing, have something else more appetizing to tempt her to eat more of it.

THE NECESSARY EQUIPMENT.

(a) **Houses.**— We have already intimated that the houses must be clean and comfortable. In order to be comfortable they need not be made warm with artificial heat. Fowls will endure intense cold if it is dry cold. Their bodies generate enough heat, if properly conserved, to keep them comfortable through the danger period — the night time. In the day they should have an opportunity to exercise and make their blood circulate in scratching in the litter on the floor for their grain ration.

The simplest and best houses are usually about 12 feet wide and of any length desired so as to be divided into compartments each 12 feet square. The rear posts are four and one-half feet high, the front posts five and one-half feet high, the rear rafter nine feet long, and the front rafters five feet long. This makes a house low at the back and only seven feet high at the apex of the rafters, which is about two-thirds of the distance from the rear to the front.

When the rafters are set, sheeting boards are put on the back and roof lengthwise. Over these the best quality of three-ply tarred paper is placed, running from the ground at the rear to the front eaves. This, if treated to a coat of hot gas tar, twice the first year and once each year thereafter, will last for a dozen years or more, and it will be a house “air-tight at the back.” The front and ends may be covered with finished weather-boarding and painted, but if so the ends should be lined with the tarred paper.

Be sure that the house is only four and one-half feet high at the back. Build the dropping-boards three and one-half feet wide, exactly half way between the floor and the roof. Use 2 × 4-inch scantling, flat side up, and running lengthwise of the house, for perches. These, if placed six inches above the dropping-boards, will place your fowls at night 10 feet distance from the front or cold portion of the house and will give them a very limited space overhead, so the warmth of their bodies will not be scattered but will be retained where it will keep most combs from freezing in the coldest weather.

Put one window in the front of each compartment. Do not be too lavish of glass. It radiates the heat and makes the house cold at night. A window 2½ × 4½ feet is large enough. If hung on hinges, it serves as a door through which one can step out from each compartment into its corresponding yard in front. A small exit hole, 8 × 14 inches, in the front for the use of the fowls makes sufficient ventilation in winter. In April the glass hinged windows may be removed and replaced until November or later with wire-screening doors.

All nest boxes, feed boxes, etc., should be attached to the front and sides of each compartment, one and one-half feet above the floor, so as to leave the entire floor area for scratching room for the fowls.

Each compartment being 12 × 12 feet, and each hen requiring a floor area of six square feet in order that she may have sufficient room for healthful exercise, it will be readily seen that 24 hens is the proper number of occupants for each compartment. A house of this kind, 120 feet long, divided into 10 compartments, holding 240 hens, should not cost more than $480, or $2 per hen. Do not be deluded into the idea of making the walls double and stuffing the space between with straw or sawdust. The thin walls, if made air-tight as directed, are better in every respect and the house will be dryer and more wholesome.

(b) **Incubators and Brooders.**— Better buy these from those who have learned how to make them. There are a dozen good incubators on the market. Purchase the one that seems to you simplest and best. After some experience you may learn to make large box brooders out of discarded piano boxes that will save you some money, and give greater area for the chicks than the brooders you buy. Those of the writer are 5½ × 5½ feet, two feet high at the back, three and one-half feet high at the front, with a 2 × 3 feet window in the front. They are built on 12-inch plank set edgewise for a foundation, thus allowing room for the lamp-box underneath the back. When chicks no longer need artificial heat, the heating apparatus may be removed and this brooder used as a colony house for the youngsters until cold weather.

THE PROFIT OF THE INDUSTRY.

This must depend largely upon the intelligence, skill, energy and location of the operator. On farms the cost of food seldom exceeds $1.25 per hen per year. Where everything is bought, in most localities it need not exceed $2.25 per hen. It is a poor class of hens that cannot be made to average 120 eggs each, and it is a poor manager, anywhere east of the Missouri River, who cannot realize three cents each for those eggs. Deducting food cost of $1.25 the returns for labor and investment are $2.35 per hen. Many are averaging 180 eggs per hen and receiving four or more cents each for the eggs, which brings the income on the egg business up to approximately $5 per hen.

The best poulterers are combining the branches of the industry by raising pure-bred birds of some variety popular and saleable. They sell most of their surplus eggs for hatching during February, March, April and May, the price they realize varying with their reputations, from five cents to $1.00 per egg.

Their next sales are from the cull male birds of their early hatchings. These go for broilers, at from 75 cents to $1.50 each, from April to July. The early hatched chicks at one pound each bring more than those three times as large but later, in the Eastern cities.

The early hatched pullets become egg-producers by August and September, just in time to replace the hens that have quit laying on account of the molting. The choicest of both sexes are reserved for breeding, show or sale purposes and bring fancy prices. It is no unusual return for such a fancier to have an income of from $5 to $10 for every hen that he starts the year with, before that year closes.

For bibliography see article POULTRY; also consult Valentine, C. S., 'The Beginner in Poultry' 1912; id., 'How to Keep Hens for Profit' (1910).

POUNCE (a corruption of pumice), cuttlefish bone or gum sandarach. The resin of the sandarach tree, ground very fine, was used formerly to prevent the spreading of ink on the surface of vellum, parchment or paper where it had been roughened by erasures. In a more general way the term pounce was also used, previous to the invention of blotting paper, for the finely ground black sand which was generally used for the purpose of drying ink. The container in which this sand was kept and which was to be found on every writing desk was known under the name "pounce box" or "pouncet box." Finely powdered gum of the juniper tree or pipe clay, darkened by an admixture of charcoal, is also known as pounce when used for the purpose of transferring designs from the original to some other material. This is accomplished by punching small holes along the outline of the original design and shaking through these openings the darkened pounce which will fall thereby on the material onto which the design is to be transferred in such a manner that the original design can easily be traced in its complete form by means of a pencil, brush or similar instrument.

POUND, Ezra Loomis, American poet: b. Hailey, Idaho, 30 Oct. 1885. He was educated at Hamilton College and at the University of Pennsylvania. He later traveled in Spain, Italy and Provence, engaged in literary studies. He became known for his verse and has also produced several translations and some prose work. He was literary executor for Ernest Fenollosa's work on Japanese classical drama and on Japanese and Chinese poetry. He has contributed to the *Fortnightly Review*, the *Quarterly Review*, *Blast* and other publications, and makes his home in London, England. Author of, verse, 'Persona' (1909); 'Exultations' (1909); 'Ripostes' (1912); 'Cathay' (1915); 'Lustra' (1916), etc.; prose, 'The Spirit of Romance' (1910); 'Gaudier Brzesha' (1916). His translations include 'The Sonnets and Ballads of Guido Cavalcanti' (1912–13); 'Certain Noble Plays of Japan' (1916). He edited 'The Catholic Anthology' (1915).

POUND, Roscoe, American college professor: b. Lincoln, Neb., 27 Oct. 1870. He was graduated at the University of Nebraska in 1888 and later studied at the Harvard Law

School. He was admitted to the bar in 1890 and engaged in practice at Lincoln, Neb. He was assistant professor of law at the University of Nebraska in 1899–1903, and dean of the law faculty there in 1903–07. He was professor of law at the Northwestern University in 1907–09 and at the University of Chicago in 1909–10. He was Story professor of law at Harvard in 1910–13, and has since been Carter professor of jurisprudence there. He was commissioner of appeals of the Supreme Court of Nebraska in 1901–03; and commissioner from Nebraska on uniform State laws in 1904–07. He was president of the Association of American Law Schools in 1911. Author of 'Readings on the History and System of the Common Law' (1904); 'Readings on Roman Law' (1906); 'Lectures on the Philosophy of Freemasonry' (1915), etc.

POUND, (1) an English weight of two different donominations, *avoirdupois* and *troy*. Since 1856 the legal original standard weight in Great Britain and her colonies has been the imperial pound avoirdupois, a cylindrical mass of platinum, grooved near the top and bearing the mark «P. S. 1844 1 lb.,» the two letters P. S. signifying «Parliamentary Standard.» The pound troy in Great Britain is defined as 5,760 grains and is divided into 12 ounces, being used almost entirely for weighing gold, silver and precious stones; the pound avoirdupois contains 7,000 grains, divided into 16 ounces, and is used for all ordinary commodities. The imperial standard troy pound constructed in 1758 was the only legal original standard weight between the years 1824 and 1856, but previous to these years certain weights, both troy and avoirdupois, had been the standards. These standards were not very accurately constructed, and through constant use became worn, but the pound avoirdupois probably contained as much as 7,002 of our present grains, while the pound troy weighed 5,759 grains. In the United States the British imperial pound avoirdupois has been copied to a great extent, but in theory the pound avoirdupois of Elizabeth is legal in this country. Edward III, from evidence in the official records, made the pound avoirdupois the standard, and Elizabeth probably copied her standard from his 56-pound weight, although standards had existed since 1497. The troy pound derives its name from the city of Troyes, where it was used as the standard of weight in the fairs held in that city. In 1497 it was made the legal weight for gold and silver and some authorities claim it was also used for bread, being known as the «old commercial weight of England,» and containing 7,600 grains. This troy pound displaced the monetary pound which had been in use from the times of the Saxons, and which contained 5,400 or 5,420 grains and was divided into 12 ounces or 20 shillings. At about the same time the merchant's pound containing 6,775 grains, divided into 15 ounces, came into considerable use. The apothecaries' pound is now obsolete. (2) Pound is also the highest monetary denomination used in British accounts, being equivalent to 20 shillings or 240 pence, and originally to a pound weight of silver (or of the alloy used). The pound (£) weighs 123.274 grains and contains 113.001 grains of fine gold. In the use of pound as designating money, the epithet *sterling* is generally affixed to discriminate from the pound weight. (See WEIGHTS AND MEASURES). (3) In law, an enclosed space for keeping cattle which have strayed on another man's ground, until they are replevined or redeemed. When cattle are put into pound it falls to the person impounding them to feed them, but he is entitled to charge the owner of the cattle the cost of keeping them in settling with him for the amount of damages to be paid. In England, an attempt to release from a pound cattle lawfully impounded is punishable by a fine. In Scotland the seizing of stray cattle and keeping them till damages are paid is called poinding of cattle.

POUND-NET FISHING, any fishing which is conducted by means of fixed enclosures of considerable size into which the fish are led by suitable guides, and within which they are confined by appropriate devices. Under this head will be included the pound-nets proper and trap-nets, as well as the simpler forms of weirs, which together constitute a class of automatic fishing gear quite distinct from the various forms of seines, gill-nets, etc., on the one hand, and the small fish-traps, baskets and eel-pots on the other. Devices of this sort are employed in the prosecution of the fisheries in many parts of the world, but the method, although not originating in the United States, has here been more highly elaborated and is more characteristic of our fisheries than elsewhere. The precise form and construction of pound-nets varies greatly in different localities, owing to the necessity of adapting it to local conditions of bottom, tides, currents, the kind and number of the fish sought, the available capital, resourcefulness of the fishermen, etc. The terms weir and pound in connection with the fisheries are to a great extent used interchangeably, according to local custom. The chief distinction between a weir and a pound-net seems to lie in the character of the enclosure within which the fish are confined. In the former this is more fixed and has no bottom which can be lifted; in the latter the pound is a netting bag which can be raised to the surface.

The most primitive apparatus of this sort in use in the United States is represented by the brush weirs employed in the herring fisheries of Maine and Canada. These consist of brush walls constructed of stout stakes driven into the bottom to a distance of about six feet and three feet apart. Between these brush, preferably of cedar or spruce for the bottom course, is woven in and out and held firmly in place by smaller stakes placed on the outside and bound to the large body-stakes. Toward the top a looser construction is adopted and the brush is placed vertically, as being less liable to be carried away by the current. Sometimes the brush is constructed in sections ashore and subsequently attached to stakes driven in the proper positions. This has the advantage that the brush sections can be removed and saved at the close of the fishing season, whereas the ordinary weirs, with the exception of such brush as can be removed from the tops, are likely to be totally destroyed by the winter's storms. When weirs are located on a bottom of solid rock into which no stakes can be driven, recourse is had to the construction of a platform of solid plank, which serves as a bottom to which the poles are fastened.

The whole is heavily weighted and held in place by loading it with stones.

A pound-net in the more restricted sense of the term is constructed entirely of cordage netting, supported and held in place by stakes, and consists of three essential parts; the pound or bowl, the wings and the leader. The pound is located off-shore, usually in from two to four fathoms of water and consists of a bag of very stout netting of about one inch mesh, the margin of which is supported above the level of the water by stout upright stakes driven into the bottom at suitable intervals which vary with the character of the ground and the force of the waves and currents. Where the bottom is rocky further security is found by the attachment of anchored guy ropes to some of the stakes. The only opening in the pound is the slit-like entrance, usually about six feet across, on the in-shore side. At this point the walls of the net are carried inward, in order to render the opening less conspicuous from the inside, and are so arranged that by means of suitable ropes they may be used to close the opening when the net is drawn. The bottom of the pound is spread and secured by means of ropes which pass through loops or pulleys near the bottom of the stakes.

The wings are vertical fences of netting, diverging from the entrance to the pound and having a length of 100 feet or more. The ends directed toward the shore are carried toward one another in the form of a semi-circle, but leaving a wide opening between the two wings. The netting of which the wings are constructed is lighter than that forming the pound, and of about one and one-half inches mesh. It is supported by stakes and reaches from the bottom to the surface, the lower border being weighted with a heavy chain.

Any form of enclosure employed in the capture of fish may be called a trap, and trap-net is frequently used as an equivalent of pound-net. The best usage of the term, however, is to indicate those forms of pound-nets which are especially adapted to deep waters or a considerable tidal rise and fall by the attachment to the upper margin of the nets of floats which keep it always level with the surface. When surface-swimming fish only are sought, the parts which correspond to the leaders and wings of pound-nets frequently hang suspended above the bottom. The whole is of course held in position by a suitable system of ropes, anchors and moorings. This type of apparatus is an approach to the floating gill-net, the sets of which are often arranged in the form of leaders and enclosures. Much information relating to all phases of the use of pound-nets in the American fisheries will be found scattered through the 'Annual Reports' of the United States Bureau of Fisheries and of the commissions of the various States in which these fisheries are located, and especially in the 'Fisheries Industries of the United States' (Washington 1884–87).

POUNDAL. See FORCE; MECHANICS.

POURBUS, poor-büs, **Frans,** THE ELDER, Flemish painter: b. Bruges, 1545; d. Antwerp, 19 Sept. 1581. He was a pupil of his father Pieter, the Younger, and of Frans Floris, and became a free master of the Guild of Saint Luke at Antwerp in 1564. He died of a malignant fever caught in the guard house of the civic guard of which he was standard bearer. His wife, the daughter of Frans Floris, married Jordaens, the painter, after the death of Pourbus. He painted historical subjects, landscapes, animals and portraits; in the last-named department his work is best known. Several religious subjects are to be found in the cathedral of Ghent and in churches of Antwerp and Oudenarde. Other works by him are in museums of Antwerp, Berlin, Brussels, Ghent, Petrograd and Vienna.

POURBUS, Frans (THE YOUNGER), Flemish painter: b. Antwerp, 1569; d. Paris, 1622. He was a pupil of his father Frans Pourbus, the Elder, and doubtless studied with others, for his father died when he was 12. He was a free master of the Guild of Saint Luke in 1591. After 1600 he resided at Brussels, then in Italy at the court of the Duke of Mantua, and after 1610 was court painter to Henry IV of France. Of the latter monarch he painted several portraits; he painted also Marie de'-Medici, the Louvre portrait of the queen being accounted his greatest work. Works by him are to be found in museums at Hampton Court, Madrid, Munich, Paris, The Hague and Vienna. His portraits are inferior to those of his father in warmth of color.

POURBUS, Pieter, THE ELDER, Flemish painter: b. probably Gouda, 1463. He is supposed to be the father of Pieter the Younger and grandfather of Frans the Elder. A portrait of a goldsmith, now at Vienna, is assigned to him.

POURBUS, Pieter (THE YOUNGER), Flemish painter: b. probably Gouda, 1510 or 1513; d. Bruges, 1584. He was a pupil of his father and probably of Lancelot Blondeel whose daughter he married. In 1540 he entered the Serment des Arbaletriers de S. George and in 1543 became a free master of the Guild of Saint Luke, of which he was «doyen» in 1569 and 1580. As he did not buy his citizenship at Bruges it is argued that his father may have moved thither from Gouda before his birth. He worked as decorator and surveyor, having remarkable gifts as a geometrician; but he is known chiefly as a portrait painter. His portrait of Dr. Ambroise Paré is owned by the New York Historical Society. Other works by him are in churches of Antwerp and Bruges and in museums of Brussels, Paris, Rotterdam and Vienna.

POURTALÈS, poor'tạ-lās', COUNT **(Graf) Friedrich von,** German diplomat: b. 24 Oct. 1853. He is descended from a noble French Huguenot family domiciled in Switzerland since the revocation of the Edict of Nantes. Three brothers were made Prussian counts in 1815, and members of the family have long served Germany in bureaucratic, military and diplomatic capacities. The subject of this sketch served as lieutenant of Hussars in the German army and was attached to the Foreign Office in 1880. After serving in secretarial positions in Vienna, at The Hague and Saint Petersburg (Petrograd), he became Ambassador to Holland in 1899, to Munich in 1902, and to Russia in 1907. In the last-mentioned post he handled the negotiations preceding the European War. He did not figure prominently in the diplomatic history of that war, though the British Ambassador in Petrograd telegraphed to Sir Edward Grey on 29 July 1914: "I fear that the German Ambassador will not help to smooth matters over, if he uses to his own government the same language as he did to me to-day."

POURTALÈS, Louis François de, Swiss-American naturalist: b. Neuchâtel, Switzerland, 4 March 1824; d. Beverly Farms, Mass., 17 July 1880. He studied engineering but turned to natural science; was a pupil of Louis Agassiz (q.v.), whom he assisted in 1840 in an exploration of Alpine glaciers; and in 1847 came with him to America, where the next year he entered the United States coast-survey. He was the first in this country to attempt deep-sea dredging. Among his important researches in this field were those conducted during the Hassler expedition from Massachusetts Bay to California by way of the Straits of Magellan. From 1854 until his resignation from the survey in 1873, he was in charge of the office and field work of the tidal division. His chief work was accomplished in marine zoology, and the large collections accumulated by him in connection with that subject were deposited in the Harvard museum of comparative zoology in which he was for a number of years an assistant, and as keeper of which he succeeded Agassiz in 1873. The genus *Pourtalesia* of sea-urchins was named after him. His writings include, besides articles in scientific journals and contributions to the survey reports, the following works among several published by the Cambridge museum: ‘Contributions to the Fauna of the Gulf Stream at Great Depths’ (1863–69); ‘List of the Crinoids Obtained on the Coasts of Florida and Cuba in 1867–69’ (1869); ‘Deep-Sea Corals’ (1871); ‘The Zoological Results of the Hassler Expedition’ (with A. Agassiz, 1874); ‘Corals and Crinoids’ (1878); a report on ‘Corals and Antipatheria’ (1880).

POUSHKIN. See PUSHKIN.

POUSSIN, poo-săṅ, **Gaspar,** Italian painter: b. Rome, 1613; d. there, 15 May 1675. He was the son of a Frenchman named Dughet, who had settled at Rome but in signing his etchings he Italianized the paternal name into Duche. When his sister married Nicolas Poussin he took the name of his brother-in-law, whose studio he entered as pupil. The standard landscape of his day was that of Claude Lorraine, but Poussin was not so conventionally classical but more true to the animalism of nature than his great rival, the transparent lucidity of whose aerial perspective he never attained to. As he painted on a red background his pictures have so darkened by age that it is hard to imagine their effect when first produced. It can, however, be seen that he discerned the true lines of a landscape; that he composed with natural grace his groups of forest trees and antique ruins; and that his land storms, in which the trees seem to quiver and bend, are genuine transcripts from tempest-harried plain and mountain. He was imitated by many painters of his day. The best of his pictures are at Rome. They are painted in tempera or oil, and examples of both styles may be seen in the Palazzi Doria, Colonna Barberini, Borghese and Corsini and in the gallery of the Accademia di San Luca. At Rome he executed the frescoes ‘History of Elijah and Elisha’ in the church of San Martino a' Monti. There are pictures of his to be found in the galleries of Paris, Petrograd, Florence, Munich, Stockholm, Vienna, London, Madrid and Dresden, and a great number are scattered through the private galleries of England and through the public galleries of many small European cities. He was one of the most prolific and finished painters of his time so that to-day more than 200 of his pictures are to be found in various European galleries and collections. Two of his landscapes are in the New York Metropolitan Museum of Art.

POUSSIN, Nicolas, French painter: b. Les Andelys, Normandy, 15 June 1593; d. Rome, 19 Nov. 1665. He studied first in his native place, and then at Paris. He had already acquired considerable reputation when, in 1624, he went to Italy, where at Rome, Marini, the poet, inspired him with a taste for the Italian poets, in whose works Poussin found many subjects for his art. After the death of Marini (1625), though left without patronage, he continued the study of geometry, perspective, architecture, anatomy, as well as the practice of his art. His conversation, his walks, his readings were also almost always connected with it. He copied antiques, modeled statues and reliefs, diligently painted from nature; and all his works show the results of this study. At last he was attacked by an illness brought on by his labors. He was, however, taken care of by a Frenchman, Jacques Dughet, the father of Gaspar Poussin (q.v.). In 1630 Poussin married the daughter of his benefactor. About this time his affairs began to improve. He found patrons in Cardinal Barberini and the Cavaliere Cassiano del Pozzo, for whom he painted the celebrated ‘Seven Sacraments.’ These works likewise gained him celebrity in France; and Cardinal Richelieu invited him to Paris to paint the great gallery of the Louvre. Louis XIII appointed him his first painter, with a pension of 3,000 livres. Poussin arrived in Paris in 1640, and executed numerous works, particularly historical pieces from the Old Testament, but was much harassed by his enemies. The painter Jacques Fouquières had been employed to decorate the gallery and the architect Mercier had overloaded it with ornament. Poussin found himself under the necessity of removing their labors. He also had to contend with the whole school of Simon Vouet. Harassed on every side he determined to leave Paris. In September 1642 while employed on cartoons of the ‘Labors of Hercules’ for the gallery of the Louvre, he returned to Rome (ostensibly for the purpose of bringing his wife to France) and never again quitted that city. The second period of his life in Rome was even more productive than the first. Many of his works were the result of orders that came to him from admirers in Paris, especially from de Chantelou, an influential courtier, for whom he painted, between 1644 and 1648, a second series of ‘The Seven Sacraments.’ As a painter his drawing is remarkably correct; his composition dignified and noble; his invention rich; his style grand and heroic. His expression approaches that of Raphael, and he has been called the Raphael of France. He has been censured for a too studied arrangement and a too great propensity to episodes; too much uniformity in the attitudes, air and expression of his figures; an excessive fulness in the drapery and too small proportions in his figures — faults which may have been owing to his close imitation of the ancients. But notwithstanding these faults Poussin may be compared with the greatest Italian masters. Among his most celebrated works are 'Seven Sacraments'; 'Deluge'; 'Death of Germanicus'; 'Capture of Jerusalem'; 'Plague of the Philistines'; 'Rebecca'; 'The Adulteress'; 'The Infant Moses'; 'Moses bringing Water from the Rock'; 'The Worship of the Golden Calf'; 'John Baptizing in the Wilderness,' etc., and many fine landscapes. The largest collection of Poussin's works is to be found in Paris, the Louvre alone containing 39. London, too, holds many of his paintings, and practically every one of the more important European galleries owns specimens of his work. Only comparatively few, however, have remained in Rome. Three of his pictures may be seen in the New York Metropolitan Museum of Art.

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POUT, or HORNED POUT. See Bullheads.

POUTER, a variety of fancy pigeon, the chief character of which is its projecting highly inflatable breast. See Pigeon.

POUTRINCOURT, Jean de Biencourt. See Biencourt de Poutrincourt, Jean.

POW-WOW, an American Indian term meaning (1) a ceremony, with conjurations, held for the curing of diseases; (2) a consultation of chiefs or leaders; a deliberation over important tribal matters. In colloquial use pow-wow is used in American politics as applied to any noisy meeting or gathering.

POWDER, a general name applied to explosive as gunpowder, giant powder, etc. See Explosives.

POWDER-DOWN FEATHERS. See Plumage.

POWDERLY, Terence Vincent, American labor leader and lawyer: b. Carbondale, Pa., 22 Jan. 1849. His early education was obtained in the public schools and he then (1862) became a railroad switch tender. At 17 he became a machinist's apprentice, settled in Scranton, Pa., in 1866, and there worked as a machinist until 1877. He was elected mayor of that city on the labor ticket in 1877 and re-elected in 1880 and 1882. He was General Master-Workman of the Knights of Labor in 1879–93, but resigning in the last-named year took up the study of law and was admitted to the bar of Lackawanna County in 1894, and in 1901 to that of the Supreme Court of the United States. He was United States commissioner-general of immigration 1897–1902, special representative of the Department of Commerce and Labor to study causes of emigration from Europe 1906 and since 1907 has been Chief of Division of Information in Bureau of Immigration to distribute immigrants throughout the United States. He has lectured frequently, made many Republican campaign speeches in 1896 and 1900 and published 'Thirty Years of Labor 1858–89' (1899–1900); 'History of Labor Day'; and articles on economics in numerous magazines. In collaboration with S. C. T. Dodd he published 'Trusts' (1892) and also contributed with others to 'The Labor Movement' (1887).

POWELL, Baden, English Anglican clergyman and mathematician: b. Stamford Hill, London, 22 Aug. 1796; d. London, 11 June 1860. He was graduated from Oriel College, Oxford, in 1817, took orders in the English Church and became vicar of Plumstead, Kent, in 1821. He was elected a Fellow of the Royal Society in 1824, and in 1827 was appointed Savilian professor of geometry at Oxford, on which occasion he resigned his living of Plumstead. He was the father of the famous English general, Sir Robert S. S. Baden-Powell (q.v.). He contributed many papers on optics, radiant heat and other physical subjects to the 'Philosophical Transactions'; and published a 'History of Natural Philosophy' (1834); but he is better known by his essay "On the Study of the Evidences of Christianity" (in 'Essays and Reviews,' 1860). Earlier theological works of a similarly liberal character are 'The Connexion of Natural and Divine Truth' (1838); 'Tradition Unveiled' (1839); 'The Unity of Worlds' (1855); 'The Study of Natural Theology' (1856); 'Christianity without Judaism' (1857); and 'The Order of Nature' (1859).

POWELL, Edward Payson, American Unitarian clergyman and author: b. Clinton, N. Y., 9 May 1833; d. Sorento, Fla., 14 May 1915. He was graduated from Hamilton College in his native town and from Union Theological Seminary, New York, in 1858. Entering the Congregational ministry he was pastor at Adrian, Mich., 1861–71, and of the Mayflower Congregational Church, Saint Louis, 1871–74. From 1874 to 1877 he held a Unitarian pastorate in Chicago and has since been editorially connected with secular and religious journals to which he has contributed numerous articles on outdoor life and kindred subjects. He has published 'Our Heredity from God' (1886); 'Liberty and Life' (1890); 'Nullification and Secession in the United States' (1896); 'Wind-breaks, Hedges and Shelters' (1900); 'The Country Home' (1904); 'In the Orchard and Fruit Garden' (1905); 'How to Live in the Country' (1910).

POWELL, Frederick York, English historian: b. London, 14 Jan. 1850; d. Oxford, 8 May 1904. He was educated at Rugby and

Christ Church, Oxford, and was appointed regius professor of modern history at Oxford, in 1894, succeeding Froude. He also acted as the University's delegate to the Clarendon Press. He was especially known as an Icelandic scholar. Together with Dr. Gudbrand Vigfússon he edited 'Icelandic Antiqua' (1876); 'Icelandic Prose Reader' (1881); 'Corpus Poeticum Boreale: The Poetry of the Old Northern Tongue from the Earliest Times to the Thirteenth Century' (1883); and 'Origines Islandicae' 1905. Although not possessing as great or as wide a reputation as some of his predecessors at Oxford, he was a scholar of deep learning and a man of broad sympathies. He was an extensive contributor to newspapers and journals on historical and literary subjects. He published a number of historical books, the most important of which are 'Early England up to the Norman Conquest' (1876); 'Old Stories from British History' (1882); 'History of England from the Earliest Times to the Death of Henry VII' (1885); 'The Tale of Throud of Gate' (1896); and 'Quatrains from Omar Khayyâm' (1901). He also acted as editor of 'English History by Contemporary Writers' (1887); and 'Scottish History by Contemporary Writers' (1890). Consult Elton, Oliver, 'Frederick York Powell' (Oxford 1906).

POWELL, John Wesley, American geologist: b. Mount Morris, N. Y., 24 March 1834; d. Haven, Maine, 23 Sept. 1902. He was educated at Illinois and Wheaton colleges, studied also at Oberlin and made researches in natural history and geology. At the outbreak of the Civil War he enlisted as a private in the 20th Illinois volunteers. As a result of a severe wound, suffered in the battle of Shiloh, he lost his right arm. At the expiration of his term of service in the spring of 1865 he returned to civil life, after having been promoted to the rank of major. In 1865 he was appointed professor of geology and curator of the museum at Illinois Wesleyan University at Bloomington, and in 1867 lecturer and curator at the State Normal University. He conducted in 1868 a perilous exploration of the grand canyon of the Colorado, and in 1870 took charge of the newly established geological and topographical survey of the Colorado River of the West. By this survey nearly 100,000 miles of the Colorado Valley were carefully explored. The work was subsequently transferred to the Interior Department. By 1874 there were four surveys in the field, and this led in 1879 to the establishment of the organization known as the United States Geological Survey, in the formation of which Powell was largely instrumental. From 1881 to 1894 he was director of the survey. He also made a particular study of American ethnology and obtained the organization of the Bureau of Ethnology, of which he was the director until his death and which he trained to a high plane of scientific efficiency. His studies of the Indians are deemed of great value. As administrator of the survey, which included also economic geology, geography and palæontology, he was very successful. Later in his life he devoted considerable attention to philosophy and psychology. He secured valuable legislation in connection with the land laws affecting the development of the arid West. In May 1918 a memorial in form of a stone altar supporting a bronze tablet engraved with a brief account of Powell's expedition to the Grand Canyon of Colorado was erected on the brink of the Grand Canyon in commemoration of the explorations accomplished by the expedition. Among his writings are 'Exploration of the Colorado River' (1875); 'Report on the Geology of the Uinta Mountains' (1876); 'Introduction to the Study of Indian Languages' (1877); 'Studies in Sociology' (1887); 'Indian Linguistic Families of America, North of Mexico' 1891); 'Canyons of the Colorado' (1895); 'Truth and Error; or the Science of Intellection' (1898); and 'First Through the Grand Canyon' (1915).

POWELL, Lyman Pierson, American college president: b. Farmington, Del., 21 Sept. 1866. He was educated at Johns Hopkins University and the University of Wisconsin and in 1893–95 he was a Fellow of the University of Pennsylvania. He was ordained deacon in the Protestant Episcopal Church in 1897 and priest in 1898; was rector at Landsdowne, Pa., in 1898–1903, and at Northampton, Mass., in 1901–12. In 1912 he became professor of business ethics at New York University and since 1913 he has been president of Hobart College and William Smith College. He edited 'American Historic Towns' (4 vols., 1898–1902); 'Current Religious Literature' (1902); 'Devotional Series' (3 vols., 1905–07); 'Religion in Our Colleges and Universities' (1912); and is author of 'The History of Education in Delaware' (1893); 'Family Prayers' (1905); 'Christian Science — the Faith and its Founder' (1907; 'Heavenly Heretics' (1910).

POWELL, Maud (MME. H. GODFREY TURNER), American violinist: b. Peru, Ill., 22 Aug. 1868. She received her musical education at Chicago, Leipzig, Paris and Berlin, studying under William Lewis, Henri Schradiech, Dancla and Joachim and made her début at Berlin in 1885. She was married to H. Godfrey Turner of London in 1904. She has been soloist with many great orchestras, including those of Thomas, Siedl, Gericke, Nikisch and Damrosch. She toured Germany and Austria with the New York Arion Society in 1892; the British Isles and European countries in 1899–1901, and in 1903–05; and also toured South Africa in 1905. Since 1903 she has appeared in America every musical season. She attained a high reputation and holds a large and appreciative following. She is noted for her interest in new compositions and in arousing her audiences to appreciation of them, and she is likewise keenly on the elert for excellence in the work of American composers.

POWELL, William Byrd, American physician and cerebral physiologist: b. Bourbon County, Ky., 8 Jan. 1799; d. Henderson, Ky., 3 July 1867. He became noted by reason of his work, 'The Natural History of the Human Temperament' (1856), announcing the theory known as Powell's life-line, and his novel views concerning the results of marriage within near or prohibited degrees of consanguinity. He was graduated from Transylvania University, at Lexington, Ky., in 1820, and from the Transylvania Medical School in 1823. In 1835 he was appointed professor of chemistry in the Medical College of Louisiana, holding that position for several years. In 1843 he began a sojourn among the American Indians, adopting their dress and manners in order to study their habits, dispositions, longevity, etc., and secured the crania of many warriors and chiefs. In 1849 he organized at Memphis, Tenn., the Memphis Medical Institute, heading its department of cerebral physiology. He held a similar position in the Cincinnati Eclectic Medical Institute 1856–59. In 1865 he was made professor emeritus of cerebral physiology in the New York Eclectic Medical Institute. He bequeathed his head to his literary executor to be preserved with his collection of crania containing some 500 specimens. He was a member of many domestic and foreign scientific societies and a frequent contributor to medical journals. Beside 'The Natural History of the Human Temperament' (1856) he published 'Eclectic Treatise on the Diseases of Children' (1857); and, with Dr. Robert S. Newman, 'The Eclectic Practice of Medicine' (1857).

POWELSON, Wilfred Van Nest, American naval officer: b. Middletown, N. Y., 15 Sept. 1872. He was graduated from the United States Naval Academy in 1893 and was then sent by the government to study naval architecture at the University of Glasgow. While serving on the *Fern* at Key West he was ordered to pursue examinations regarding the destruction of the *Maine* in the harbor of Havana and his published report stating that the *Maine* was sunk by an exploded mine was much discussed by scientific periodicals. He was promoted lieutenant in March 1901 and retired in 1902. After becoming general manager of the Union Electric Light and Power Company of Saint Louis, Mo., in 1904, and president and treasurer in 1906, he has been, since 1908, a member of a New York firm of consulting engineers and managers of public utilities corporations.

POWER, Frederick Belding, American chemist: b. Hudson, N. Y., 4 March 1853. He was graduated at the Philadelphia College of Pharmacy in 1874 and at the University of Strassburg in 1880. He was professor of analytical chemistry at the Philadelphia College of Pharmacy in 1881–83; professor of pharmacy and materia medica at the University of Wisconsin in 1883–92; director of the laboratories of Fritzsche Brothers in 1892–96; and in 1896–1914 was director at the Wellcome Chemical Research Laboratories, London, England. He was awarded the Ebert Prize of the American Pharmaceutical Association in 1887, 1902 and 1906; and received gold medals at the Saint Louis Exposition, 1904, at Milan in 1906, at the Franco-British Exposition in 1908; grand prize at Brussels in 1910; the gold medal at Turin in 1911, and the Hamburg gold medal in 1913. He was a member of the Committee of Revision of the United States Pharmacopœia in 1890; and United States delegate to the International Congress for the Unification of the Formulæ of Potent Medicaments at Brussels in 1902. With Dr. Fred Hoffmann he edited 'Manual of Chemical Analysis' (1883).

POWER (William Grattan), Tyrone, Irish actor: b. near Kilmacthomas, County Waterford, 1795; lost at sea, 1841. He made his début as Orlando in 'As You Like It' in 1811 at Monmouth, Wales. In 1822 he appeared in London, where he made a hit as Larry Hooligan O'Halloran in 1824, and henceforth devoted himself to impersonations of Irish characters in which he was inimitable. He visited the United States in 1833, 1836 and in 1840, and in 1841 embarked for Europe on the *President*, which was never heard of. He published two novels, 'The King's Secret' and 'The Lost Heir'; a number of plays; and 'Impressions of America' (1836). Consult Winter, William, 'Tyrone Power' (New York 1913).

POWER, *in arithmetic,* and in the algebra of real numbers, the product obtained by multiplying a given number by itself a specified number of times. If x is the given number, and n is the number of times that x is taken as a factor in forming the product, then the product that is finally obtained is

$$x \times x \times x \times \quad . \quad . \quad . \quad . \quad \times x \times x \times x$$

(n factors altogether)

This is called the "nth power" of the number x, and is represented by the symbol x^n. Assuming for the moment that n (which is called the "exponent" of the power) is positive and integral (since this is the only case in which the foregoing definition is applicable), we easily obtain the following general laws which the powers of numbers must fulfil: x^{m+n}; $(x^m)^n = x^{mn}$; $(xy)^n = x^n y^n$. To extend the conception of a "power" so as to permit of the use of fractional and negative exponents, we may assume that the foregoing laws hold true of all real exponents, and from them we may seek the interpretations that must be given to an expression of the form x^n, when n is fractional or negative. First, if we make $m = 0$ in the equation $x^m . x^n = x^{m+n}$ we have $x^0 . x^n = x^n$; and hence we conclude that the symbol x^0 must be interpreted as representing unity in all cases. Again, if we make $n = -m$, we have, from the first of the general relations given above, $x^m . x^{-m} = x^{m-m} = x^0 = 1$ and hence we must interpret the expression x^{-m} as signifying the reciprocal of x^m. We may ascertain the significance of a fractional exponent by means of the second general relation, above. Thus in the identity $(x^m)^n = x^{mn}$, let us put $m = 1$. Then we have $\left(\frac{1}{x^n}\right)^n = \frac{1}{x^n} = x^1 = x$. Hence $\frac{1}{x^n}$ must be interpreted as representing one of those quantities which, when raised to the nth power, will yield x itself. That is, we must interpret $\left(\frac{1}{x^n}\right)$ as equivalent to $\sqrt[n]{x}$. In general, this will be a many valued function. If x is real, $\sqrt[n]{x}$ is often interpreted as the positive real number which when raised to the nth power gives x. This is only one of the values of $\frac{1}{x^n}$. In a similar manner it is easily shown that the symol $\frac{m}{x^n}$ must be interpreted as equivalent to $\sqrt[m]{x^m}$.

The significance of a power, when the exponent is irrational or imaginary, is considered in the theory of functions, but these generalizations are too difficult for sound treatment in the present article. For this aspect of the subject, and for the discussion of the development of functions of a variable in a series whose terms are powers of that variable, consult Harkness and Morley, ‘Introduction to the Theory of Analytic Functions’ (London 1898).

POWER, *in mechanics and physics,* the rate at which work is performed; or (what is the same thing), the quantity of work that is performed *per unit of time.* In ordinary engineering practice in the United States and England, the unit of work is the “foot-pound;” a foot-pound being defined as the quantity of work that is performed when a force equal to the weight of one pound of matter is exerted through a distance of one foot. (See MECHANICS). Nothing is here specified, it will be observed, as to the *time* in which this work is done. A small motor, for example, might require 10 seconds to accomplish it, while a more powerful one might perform it in a very small fraction of one second. The work that is performed by a given motor or engine in one second, or in one minute, is therefore the true measure of the “power” that is being developed. James Watt adopted the “horse power” as the unit of power for steam engines and other large motors, and this has been universally adopted, since his time, in all English-speaking countries. He estimated that a strong horse is capable of performing 33,000 foot-pounds of work per minute; and although it is known that the horse cannot work continuously at this rate, his definition has never been modified, and in steam and hydraulic engineering a “horse power” is still understood to signify the performance of 33,000 foot-pounds of work per minute, or (what is the same thing) 550 foot-pounds per second. The horse power of an engine or a water-wheel is therefore determined by observing how many foot-pounds of work it is performing per minute, and dividing this number by 33,000. In the centimeter-gram-second system of units, which is in extensive and increasing use in modern physics, the unit of work is the “erg,” and the unit of power is the “watt”; a watt being defined as the power that is developed when 10,000,000 (that is 10^7) ergs of work are performed per second. The watt is employed in practical electrical engineering, as well as in experimental physics; it being then defined as the rate at which work is being done in a circuit in which the current is one ampere, and the electromotive force is one volt. This change in definition is merely a matter of convenience, since it may be shown that the two definitions amount to precisely the same thing. A horse power is approximately equal to 746 watts. Consult Everett, ‘Units and Physical Constants.’ See also the article UNITS OF MEASUREMENT.

POWER, Utilization of. The economical production of manufactures and the convenient adaptations of time- and labor-saving devices in all the various lines of constructional work have exerted a wonderful influence in the upbuilding of American industries. Among other significant features the present tendency is marked by the adaptation of compressed air and the application of electric power to machine driving. In the use of compressed air, the facility of adaptation to various requirements which are in many cases additional to the supply of motive power, is a valuable feature peculiar to this system and one which is susceptible of extension along many lines. The labor cost in most machine shops and other works is so much greater than the cost of power that any expedient by which the labor cost may be appreciably reduced is justified, even though the efficiency of the agent itself be low. Whenever new methods or agencies cause an increased production with a given outlay for labor, these methods will supersede the old, even though the cost of the power required be greater than before. The saving of power is a consideration secondary to the advantages and economical output obtained by its use. While economy in the use of power should therefore be secondary to increased output, yet careful attention to details will often greatly reduce the useless waste of power. Engineers have recognized that there is a very great percentage of loss due to shaft friction, which, in railroad and other shops where the buildings are more or less scattered, may be as great as 75 or even 80 per cent of the total power used. In the ordinary machine shop this loss will probably average from 30 to 50 per cent. No matter how well a long line of shafting may have been erected, it soon loses its alignment and the power necessary to rotate it is increased.

Manufacturers are realizing the loss of power which ensues from the present system of mechanical transmission, and there is an increasing tendency to introduce different methods by which a part of this loss will be obviated. Among these are the adoption of hollow and lighter shafting, higher speeds and lighter pulleys, roller and ball bearings in shaft hangers, and the total or partial elimination of the shafting.

Subdivided Power.— Independent motors are often employed to drive sections of shafting and isolated machines, and among these are found steam and gas-engines, electric motors, compressed air and hydraulic motors, although the latter have not been used for this purpose to any appreciable extent. In the choice of motors, until quite recently the steam engine has generally been used, especially where the units are relatively large, but the advantages possessed by electric driving has caused the electric motor to displace the steam engine in many cases. An interesting example of this is noted in the Franklin Sugar Refining Company of Philadelphia, in which there were formerly some 90 Westinghouse engines about the works, many of them being of 75 and 100 horse power each; others of 5 and 10 horse power only. At the present time these have all been replaced with electric motors. A similar subdivided-power plant involving nearly 50 steam engines was erected some years ago at the Dunnell Print Works of the United States Finishing Company at Pawtucket, R. I. More recently many of the steam engines have been replaced by electric motors, but there are still 27 engines in use in this plant. It was not so many years ago that several large and economical Corliss engines were replaced at the Baldwin Locomotive Works by a greater number of small, simple-expansion engines, which actually required about 15 per cent more steam per horse-power hour than the Corliss engines. This loss, however, was only apparent, for by increasing the number of units and locating them at convenient centres of distribution much of the shafting and belting could be dispensed with and an actual saving of power was obtained. Later, the simple engines were replaced by a number of compounds, some 18 being in service and these showed a saving of 36 per cent over that obtained by the use of the simple engines. Subsequently, however, the electric motor (q.v.) has superseded the steam-engine for this work, as its economy and convenience over the latter are now thoroughly recognized.

Water Power.— It is estimated that there are available in this country about 61,000,000 water horse power that could be profitably utilized, of which it appears that only 6,500,000 horse power have been developed; that is, practically 54,000,000 water horse power is now going to waste. Nor does it seem likely that this power will soon be developed unless more satisfactory legislation be enacted which will afford a greater security and permit a better return to the investor in water-power development.

Electric Power.—The statistics of American manufacturing, compiled for the 1900 United States census, show that at that time electric power was less than 5 per cent of all that was in use in such plants, or about 500,000 horse power out of a total of 11,000,000. During the decade from 1899 to 1909 the total amount of primary power used in the industries throughout the United States has increased from 11,000,000 horse power to nearly 19,000,000, of which 76 per cent or a little over 14,000,000 horse power is derived from steam engines; the rest being distributed between water power, electric power and gas and internal combustion engine power. At the time of the last census there were in use in the industries nearly 5,000,000 horse power in electric motors, of which over 3,000,000 horse power, or 63 per cent, was generated by the particular establishment using the power. That is, 63 per cent of the electric power used in the industries is generated by the user, and 37 per cent is purchased. The introduction of electric power in machine shops and factories was at first looked upon with disfavor and was opposed by many manufacturers, but the innovation obtained a foothold, and advantages which were at first unforeseen were found to attend its use, so that now it is being very generally adopted for a wide variety of work. A considerable difference of opinion exists as to whether individual motors should be used with each machine, or whether a number of machines should be arranged in a group and driven from a short line shaft. There are well-defined conditions to which each system is best adapted, but there are wide limits between which there appears to be no general rule, and both methods are occupying the same field. For isolated machines and for heavy machines that may be in occasional use, the individual motor is particularly well adapted, as it consumes power only when in operation. It is, however, necessary that each motor thus connected shall be capable of supplying sufficient power to operate its machine under the heaviest as well as lightest loads. In certain cases, moreover, the load is liable to very great irregularity, as for instance in metal-working planers, in which the resistance offered by the machine at the moment of reversal of the platen is far higher than at other times, and may be so great as to endanger the armature of the motor. Under these conditions it is necessary to use a motor of much larger capacity than the average load would indicate. Ordinarily in machine driving the motor is shunt-wound, and the current through the field coils is constant under all conditions of load; but to obtain the best results with that class of machinery in which the load is intermittent and subject to sudden variations, the motor should be compound-wound so as to increase the torque without an excessive increase of current in the armature. In many cases with individual motors, owing to wide variations in power required, the average efficiency of the motor may be very low; for this reason a careful consideration of the conditions governing each case indicates that for ordinary machine-driving, especially with small machines, short lengths of light shafting may be frequently employed to good advantage, and the various machines, arranged in groups, may be driven from one motor. By this method fewer motors are required, and each may be so proportioned to the average load that it may run most of the time at its maximum efficiency. When short lengths of shafting are employed the alignment of any section is very little affected by local settling of beams or columns, and since a relatively small amount of power is transmitted by each section, the shaft may be reduced in size, thus decreasing the friction loss. Moreover, with this arrangement, as also with the independent motor, the machinery may often be placed to better advantage in order to suit a given process of manufacture; shafts may be placed at any angle without the usual complicated and often unsatisfactory devices, and setting-up room may be provided in any suitable location as required, without carrying long lines of shafting through space. This is an important consideration, for not only is the running expense reduced and the lighting increased thereby, but the clear head-room thus obtained, free from shafting, belts, ropes, pulleys and other power-transmitting devices can be more easily utilized for hoists and cranes, which have so largely come to be recognized as essential to economical manufacture.

Distribution.— In arranging such a system of power distribution the average power required to drive is of as much importance as the maximum, for in a properly arranged group system the motor capacity need not be the equivalent of the total maximum power required to operate the several machines in the group, but may be taken at some value less than the total, depending upon the number of the machines and the average period of operation. On the other hand, as already shown, the motor capacity of independently driven machines must not only equal the maximum power required to drive the machine at full load, but it must be capable of exerting a greatly increased momentary torque. In any case large units should be avoided, for the multiplication of machines driven from one motor entails additional shafting, counter-shafts and belting which may readily cause the transmission losses to be greater than those obtained with engines and shafting alone, besides frustrating some of the principal objects of this method of transmission.

As far as the efficiency of transmission is concerned, it is doubtful whether, in a large number of cases, motor-driving *per se* is any more efficient than well-arranged engines and shafting. The principal thing to be kept in mind is a desired increase in efficiency of the shop plant in turning out product, with a reduction in the time and labor items, without especial reference to the fuel items involved in the power production. On account of the subdivision of power which results from the use of many motors, there is less liability of interruption to manufacture, and in case of overtime it is not necessary to operate the whole works, with its usual heavy load of transmitting machinery. Another advantage is the adaptability to changes and extensions; new motors may always be added without affecting any already in operation, and the ease with which this system lends itself to varying the speed of different unit groups is a very potent factor in its favor. When power is delivered to the machine by direct connected motors, a serious difficulty is often experienced in obtaining speed variation, which is so necessary with a large proportion of the machines in common use. A certain amount of variation can be obtained by rheostatic control — a wasteful method; or by using a single voltage system with shunt field regulation; but the variation in either case is very limited. This, however, may be increased by using a double commutator if space will permit. The three-wire, 110–220-volt system, offers many advantages for both power and lighting systems, and is very frequently employed. Variations of speed may be obtained with this system by using a combination of field regulation with either voltage, and, in rarer cases, by the use of a double commutator motor. A method which has been used with considerable satisfaction involves the use of a three-wire generator, with collector rings connected to armature winding similar to that of a two-phase rotary converter. Balancing coils are used, and the middle points of these are connected to the third wire, which is thus maintained at a voltage half way between the outer wires. This system is simple and economical, and possesses all the advantages of the ordinary three-wire method; it permits similar variations in speed by field regulation with either voltage; and if still wider ranges are desired a double commutator motor may also be used.

In other installations the four-wire mutiple voltage system is used, which permits of very wide variations of speed in the operation of the tool. This system gives excellent results and removes one of the objections urged against direct-connected motor-driven tools, namely, that such machines are not sufficiently flexible in regard to speed variation, and that such variation can only be obtained by throwing in resistances which cut down the efficiency of the motor or by varying the strength of field which reduces the torque. The multiple voltage system, however, has some serious disadvantages. It cannot usually be operated from an outside source of power without rotary transformers; the generating sets and switchboard are complicated, and the total cost of installation is expensive; yet with these drawbacks the system is growing in favor, as it has manifest advantages which outweigh the objections. Storage battery power has been used to some extent to obtain multiple control and is suggestive of interesting possibilities, but in its present form it is not altogether desirable for this purpose. In many of the larger sizes of certain metal-cutting machines marked changes in design have taken place, and these machines are now built with direct-connected motors incorporated in them, possessing wide variations of speed and power.

Improvements in the manufacture of tool steel have shown indisputably that the older designs of machine tools are not sufficiently heavy to stand up to the work in order to obtain the economy of operation which results from the use of such steels. Higher speeds, heavier cuts and greater feeds may be obtained if the machines will stand the strain, but in most cases the capacity of the machine is not commensurate with the ability of the tool to remove metal. With cutting speeds of 100 to 200 feet per minute, it is evident that the power requirements will be much greater than for those machines which use ordinary carbon steel with cutting speeds of from 10 to 30 feet per minute. Here then is an interesting field for the direct-connected motor with ample power and speed variation for any work which it may be called upon to perform.

Compressed Air.—Reference has been made to the use of compressed air power, and its facility of adaptation to various requirements, but it is evident from an inspection of some of the devices in use that enthusiasm for new methods, rather than good judgment, has controlled in many of its applications. For some years compressed air was used only in mines, where it produced marked economics in underground work. Later, compressed air was introduced into manufacturing lines, and to-day its use in railroad and other machine shops, boiler shops, foundries and bridge works is being widely extended. In the Santa Fé Railroad shops at Topeka there are over five miles of pipe in which compressed air is carried to the different machines and labor-saving appliances throughout the works. In such shops air is used to operate riveting machines, punches, stay-bolt breakers, stay-bolt cutters, rotary tapping and drilling machines, flue rollers, rotary grinders, rotary saw for sawing car roofs, pneumatic hammers, chisels and caulking tools, flue welders, boring and valve-facing machines, rail saws, machine for revolving driving-wheels for setting valves, pneumatic painting and whitewashing machines, dusters for car seats and the operation of switching engines about the yard. It is also used in the foundry for pressing and ramming molds, and for cleaning castings by the sand blast; but its greatest field of usefulness lies in its application to hoisting and lifting operations in and about the works. More recently its use has been extended to include the sand blasting of steel passenger coaches. In mines, where exhaust steam or gas engine exhaust would interfere with proper ventilation, compressed-air engines and motors, which discharge pure air directly into the workings, are used for a variety of purposes, such as locomotive haulage, hoisting, pumping, cutting and drilling. Probably nothing has called wider attention to the possibilities of the use of compressed air than the recent installation of a system of compressed air deep-mine hoists in the Butte, Mont., mines. This is especially remarkable in view of the fact that the compressors are operated electrically from transmitted water power; it was found to be better to use electricity to operate compressors discharging into storage reservoirs from which the air passed through heaters on the way to hoisting engines than to operate the hoists electrically. One factor in this conclusion is the special construction of the engine, which as the cage descends operates as a compressor, storing air by the energy of the falling hoist, and acts as a brake at the same time.

New applications of compressed air are constantly being made, and each new use suggests another. This has a tendency to increase the number of appliances which are intended to be labor-saving devices, but in many cases the work could be done just as well and much more cheaply by hand. The success and economy which has attended the use of compressed air in so many lines of work has led to its adoption in fields which are much better covered by electrically operated machines. While compressed air has been used under certain conditions very satisfactorily to operate pumps and engines, printing-presses, individual motors for lathes, planers, slotters, dynamos and other work, it does not follow that it is always an economical agent under these various uses or that other methods could not be used even more satisfactorily. It has been proposed to use individual air motors in machine shops and do away with all line shafting, except possibly for some of the heavier machinery. This use of compressed air seems entirely outside the pale of its legitimate field; the general experience thus far indicates that rotary motors are not at all economical and generally are not as satisfactory as electric motors. Exceptions are to be found in the small portable motors for drilling and similar operations to which electricity is not so well adapted and where compressed air has been found to give excellent results. Although these tools are very successful, they are still rotary motors, not exempt from some of the objectionable features which seem to be inseparable from them. It is not surprising, therefore, to find a tendency to employ reciprocating pistons and cranks in these portable machines, and such tools are now in use weighing only 40 pounds capable of drilling up to two and a half inches diameter. In most cases no attempt has been made to use compressed air power efficiently; its great convenience and the economy produced by its displacement of hand labor have, until recently, been accepted as sufficient, and greater economies have not been sought.

In the matter of compression, very inefficient pumps are still in use, but manufacturers generally have found that it pays to use high-grade economical compressors. The greatest loss is that in the air motor itself. In a large number of cases it is impracticable or, at most, inconvenient to employ reheaters, and the air is used very generally at normal temperature for the various purposes to which it is applied. To obtain the most satisfactory results, the air must be used expansively, but usually where the demand for power is intermittent no attempt has been made to reheat the air, and as a result the combined efficiency of compressor and motor is quite low, varying in general from 20 to 50 per cent. While low-working pressures are more efficient than high, the use of such pressures would demand larger and heavier motors and other apparatus which is undesirable.

The advantages of higher pressures in reducing cost of transmission are also well recognized, and the present tendency is to use air at 100 to 150 pounds instead of the 60 or 70 pounds formerly used. By reheating the air to a temperature of about 300° F., which may often be accomplished at small expense, the efficiency is greatly increased; in some cases this has been shown to be as high as 80 per cent.

A remarkable development of compressed air power, in which very high compression is used, has recently been accomplished in the Porter compound compressed-air locomotive for use in mines, lumbering operations, powder works or other places where fire is much feared; also in hauling cars about the yards of large manufacturing plants, where cleanliness as well as avoidance of fire risk is important. In this case the air is stored in the locomotive tanks under a pressure of 800 pounds per square inch; this air thoroughly dried by the high compression then passes through a reducing valve, where it produces kinetic energy due to expansion, which it immediately loses by impact, thus avoiding temperature drop when falling from 800 to 250 pounds per square inch. At this pressure and practically atmospheric temperature the air is admitted to and expanded in the high-pressure cylinder of the locomotive, exhausting into the receiver at as low a temperature below atmosphere as practicable. Atmospheric air is blown through a series of tubes in the receiver, so that the working air takes up heat from the atmosphere and, subsequently expanding in the low-pressure cylinder, converts some of the atmospheric heat into work. This process is peculiarly interesting, in that it provides a means of reheating the working air directly from the atmospheric air and obtaining thereby an increase of 30 per cent in the economy.

While the lower pressures are in general more efficient, the loss due to higher compression is not serious. If the compressed air be used without expansion, it will be seen that there is a material loss in efficiency; but, on the other hand, if it be used expansively without reheating, trouble may be experienced, due to the drop in temperature below the freezing point. When moisture is present, this will cause the formation of ice, which may clog the passages if proper precautions are not taken to prevent it. The low temperature will not in itself cause trouble; if, therefore, the moisture which the compressed air holds in suspension be allowed to settle in a receiving tank, placed near the motor or other air apparatus and frequently drained, less trouble will be experienced from this cause. The greater adaptability of compressed air to various purposes causes its use to increase along with that of the electric motor, for it has a different field of usefulness, independent of power transmission; at the same time, when the requirements are properly observed in its production and use, its economy as a motive power in special cases compares favorably with other systems. But compressed air possesses so many advantages that, however inefficient it may be as a motive power, its application to shop processes will be continually extended as its usefulness becomes better known. See PNEUMATIC TOOLS.

Hydraulic Power.— Mention has been made of the use of hydraulic motors as a factor in the subdivision of power but these are being used to such a limited extent for this purpose that they will not be considered here. There is, however, a growing field of usefulness for hydraulic power in manufacturing operations which is peculiar to this agent alone, namely, its use in forging and similar work. Where hydraulic power exists for this purpose it is also generally used for a variety of work which could be accomplished just as well, and often more economically, by steam or compressed air; but in forging operations where heavy pressures are required hydraulic power is infinitely better than either. The compressibility of air is an objection in many lines of work, and it is now well recognized that the effect of a hammer blow is oftentimes merely local. As H. F. J. Porter has so ably shown, the pressure applied in forging a body of iron or steel should be sufficient in amount and of such a character as to penetrate to the centre and cause flowing throughout the mass; as this flowing of the metal requires a certain amount of time, the pressure should be maintained for a corresponding period. Hydraulic pressure, instead of a hammer, should, therefore, be used to work the metal into shape. Under its influence the forging is slowly acted upon and the pressure is distributed evenly throughout the mass, whereas under the high velocity of impact of the hammer the metal does not have time to flow, and thus internal strains are set up in the mass, which may cause serious results, especially with certain steels which have not the property of welding. Moreover the quality of the steel is very much improved by the processes of hydraulic forging. There exists at present a marked tendency to substitute this method in a wide variety of work in which presses are employed varying in capacity from 20 tons to 14,000 tons.

It is an interesting fact that the magnificent hammer, designed and built by the Bethlehem Steel Company, of a nominal capacity of 125 tons and an actual of 145 tons falling weight has been superseded by hydraulic presses for forging purposes. This hammer is no more in existence. The largest hammer at the Bethlehem plant to-day is a 10-ton hammer. Among the numerous hydraulic presses at Bethlehem under which forgings are made they have one of 14,000-ton capacity, operated by the world's largest land engine of 16,000 horse power.

The different hydraulic systems are as follows: (1) A pump or continuous intensifier using pressure corresponding to the resistance of the press. This pressure runs up to 7,000 pounds per square inch; (2) single stroke steam or air intensifiers where the hydraulic cylinder is filled with water, under a pressure of 2 to 50 pounds per square inch and then the pressure increased by means of the intensifier from 3,000 to 9,000 pounds per square inch.

The latest development at Bethlehem has been in high speed processes where the water is pumped, electrically, to an accumulator and from there used in the presses. This is the most economical. In presses of this nature, the cylinder is filled from a tank through a valve of very large dimensions (to date up to 16-inch in diameter) withstanding a pressure of 10,000 pounds per square inch. A water intensifier is then used; this may be one, two or three-pressure intensifier. The nominal pressure used in the lines for operating auxiliary parts of the press, together with the intensifier, is 2,500 pounds per square inch line pressure. A line pressure lower than this makes the machinery bulky and cumbersome and does not take advantage of modern steel construction, nor does it give high speed.

Any one of these presses will run up to 100 or more strokes per minute when needed. A press at Bethlehem has been tested up to 60 strokes of three feet length per minute. Most die forging presses are made of this last type. The speed of these presses may be understood when it is stated that as many as 10 projectiles are turned out per minute.

Presses are now built at the Bethlehem plant of 10,000 and more tons capacity for the manufacture of die forgings, such as car wheels, which may be produced at the rate of one a minute.

The high efficiency of the presses has chiefly been accomplished by means of the large valves and the high initial pressure in the lines, the cushioned accumulator, and the shifting tables (both in top and bottom platen). These have all been developed by the Bethlehem Company, which, at the present time, stands practically alone in the building of these enormous machines, a single one of which will weigh as much as 1,000 tons. All handling of pieces under these presses is done mechanically by hydraulic or electric power. The success which has attended the use of hydraulic power in forging is causing it to be applied to other and similar work to an increasing extent. In boiler works, railroad and locomotive shops, bridge works and shipyards it is used along with compressed air, but where heavy pressures are desired hydraulic power is greatly to be preferred; hence we find it operating machines for punching and shearing heavy plates and sectional beams, riveting machines, stationary and portable, flanging and bending machines, tube upsetting machines, wheel and crank-pin presses, lifting jacks and hoists of all kinds. For heavy boiler work hydraulic riveting seems especially well adapted, since an intensity of pressure can be brought to bear upon the plates which is obtained by no other method.

Transmission.— In the transmission of power by compressed air, within reasonable limits, the loss in transmission if the pipes be tight need not be considered, for although there is a slight loss in pressure due to the frictional resistances of the pipes, yet there is a corresponding increase in volume due to drop in pressure, so that the loss is practically inappreciable. It has already been stated that compressed air as now used without reheating is not at all efficient as a source of motive power, since the combined efficiency of compressor and motor, even under favorable conditions, is not more than 50 per cent of the available energy put into the compressor. In other cases the efficiency is as low as 20 per cent. There should be no comparison between the cost of power by compressed air and its brilliant rival, electricity, since each has its own field of usefulness. With a three-wire 220-volt-system, which is very suitable for ordinary shop transmission when both light and power are to be taken off the same circuit, the combined efficiency of generators and motors working intermittently with fluctuating loads will be about 60 per cent of the power delivered to the engine. For greater distances than those which obtain in plants of this character the loss in transmission will be greater, and higher voltage must be employed in order to keep down the line loss. While it is possible to put in conductors sufficiently large to carry the current with any assumed loss, yet the cost of the line may become prohibitive with low voltage. Where cheap fuel is available it is found in many cases that electric power can be generated at the works more cheaply than it can be purchased from a central station; especially is this the case if the exhaust steam be used for heating purposes. In isolated plants the cost of transmission is very small as compared with the total cost of generation; whereas in the average central station the cost of transmission, which includes interest and depreciation on pole line, may constitute a large percentage of the operating cost.

As already stated the last census shows that 63 per cent of the electric power used in the industries is generated by the user. In those localities where the cost of fuel is high, electric power can often be purchased more cheaply from a central station which possibly obtains its current from a water-power development many miles distant and transmits it electrically to a convenient distributing centre, where it is used for power and light. The recent advances in electrical transmission are very marked, and one constantly hears of some new achievement more wonderful than anything previously accomplished. Distances have been gradually increased until it is now not uncommon to transmit electrical energy economically and in commercial quantities up to 150 or 200 miles; in one recent case the transmission extends from the Sierras to Los Angeles, Cal., a distance of 240 miles.

If the available power cannot be utilized near at hand by centralizing the industries near the source, there is no reasonable limit to the distance to which it can be transmitted if occasion should require. The problem resolves itself largely into a question of voltage, which has steadily increased from the 4,000 to 6,000 volts in use not so many years ago to 40,000 and 60,000 volts which are now quite commonly employed; but it appears that even 60,000 volts which was regarded as a high value a few years since has been far exceeded in the most recent developments. The Los Angeles transmission line for instance uses 150,000 volts, and the hydro-electric development at Victoria Falls, in South Africa, contemplates a line pressure of 200,000 volts through a distance of 700 miles. The possibility of electrical transmission thus permits the utilization of available sources of power at great distances from the centre of distribution; but while it is interesting to know that a certain amount of power may be transmitted a given distance with a high degree of efficiency, it is more important to know whether the same amount of power could be obtained at the objective point more economically by other means.

Petroleum Fuel.— It has been suggested that the future of long-distance transmission depends largely upon the development of oil as a fuel; but at the present time the outlook for oil fuel in general competition with coal or long-distance transmission is not encouraging. While the development of the Texas and Southern California oil fields has increased the visible supply and brought about increased activity in the use of liquid fuel, yet it is doubtful whether the advantages would be sufficient to cause it to come into general use as a fuel, since with a limited production and an increased demand for this and other purposes the cost would be correspondingly increased.

A number of railroads contiguous to the oil-producing centres have equipped their locomotives to burn this fuel, and it is used to an increasing extent for marine and naval boilers, with great satisfaction,— since its displacement for a given heating value is only about one-half that of coal and the labor cost is materially reduced. It is also used quite extensively in certain sections of the country as a steam producer in power plants, but it is hardly possible that liquid fuel will be a serious competitor of coal for steam generation. At present, as far as power for manufacturing plants is concerned, it is largely a question of transportation, whether oil can be laid down and handled at a given point more cheaply than coal. It is probable, however, that oil fuel will supply a local demand in certain sections where transportation charges, and possibly insurance, will permit its use at a low cost, and it is in this connection that it may become a competitor of electrical transmission.

Internal Combustion Engines.— One interesting phase of the power problem which forcibly presents itself at the present time is the vast possibilities possessed by the modern combustion engine, which includes the various types of gas and oil engines. While its use as a motor in industrial establishments has been somewhat limited, yet there is a marked tendency to employ the gas engine in manufacturing works, and consideration of its advantages and cost of operation, together with its high thermal efficiency and possibility of still further improvement, indicates that, for a great many purposes, both steam engines and electric motors may be ultimately replaced by some form of internal combustion engine. That the gas engine in both large and small sizes has reached a point in its development where it can fairly rival the steam-engine in reliability and satisfactory running qualities there can be no question. In point of fuel economy, a gas engine of moderate size is on a parity with the largest triple-expansion steam engines, and will give a horse power on less than one pound of fuel. The high price of gas in this country has contributed largely to those causes which have prevented a more common use of the gas engine as a motor. For this reason the gas engine has generally been used, not so much because of its high efficiency as a thermo-dynamic machine, but rather on account of its convenience and saving in labor. It is true that natural gas is cheap, but it is equally true that natural gas is not generally available. Fortunately the manufacture of producer gas has reached a high state of development, and there are now in successful use several processes by which power gas can be made from cheap bituminous coals as well as anthracite and coke. The leanness of such gases renders them less effective per cubic foot of gas, as compared with the richer coal gas or even water gas; but this difference is more than compensated for by the low cost of production.

A prominent factor in gas engine practice which has attained a high degree of development in European practice is the small gas producer. These generators are very simple in operation, and furnish a convenient and economical means of obtaining power at a much lower rate than with the ordinary city lighting gas. The economy of these small producers is shown by tests which give one horse power on a 16 horse-power engine with a consumption of only 1.1 pounds of fuel. For engines above 40 horse power one horse power can be obtained on seven-eighths pound of fuel. The successful employment of large combustion engines with blast furnace gases as the explosive medium utilizes vast sources of power which a few years ago were allowed to go to waste or, at most, were used very inefficiently. The high thermal efficiency of the gas engine has long been recognized and the possibility of further development is a promising factor in this field. The accomplished efficiency of 38 per cent reported by Professor Meyer, of Göttingen, greatly exceeds the maximum theoretical efficiency of the steam engine. With higher compression even greater efficiencies may be expected. But with high compression there is danger of premature explosion, due to the generation of heat in compressing the gas in the presence of oxygen; for this reason Herr Diesel compresses the air separately. Under a pressure of 500 pounds or more, which is used in the Diesel motors, the air becomes very hot and readily ignites a charge of liquid fuel which is injected into the compression chamber. There is no explosion; combustion occurs while expansion goes on, and the heat generated disappears in the form of work. The United States census report for 1900 shows that about 135,000 horse power derived from gas or internal combustion engines were used in the industries, whereas, according to the latest (1910) report 750,000 horse power from gas and internal combustion engines were so used. That is, an increase of more than 500 per cent had taken place during the decade. The present development is toward the improvement of the internal combustion engine similar to the Diesel type, and this is accompanied by a marked tendency to use this type in marine engines; especially is this noticeable in European practice where it is employed in sizes up to 2,500 horse power per cylinder. In the larger sizes these engines are of vertical construction double acting two-cycle, and usually with six cylinders; but the fuel consumption is slightly greater in this type than in the four-cycle. The experience already obtained with Diesel engines in scores of vessels indicates that they may be made as reliable and that they are as suitable for ship propulsion as steam engines, which in a number of cases they have displaced. In many locations the crude oil used as fuel is available and cheap, and since its value in heat units per pound is from one-third to one-half greater than that of steam coal, the space occupied by the fuel in the vessel is greatly reduced; moreover remarkably high thermal efficiencies are obtained in this type of engine and even greater may be expected in the future since tests with various oil fuels have shown that thermal efficiencies of 45 to 48 per cent are possible. At the present time one ton of oil will accomplish approximately as much work in a Diesel engine as four tons of coal converted into steam power. In addition to the greater economies due to the fuel there is a marked saving in space and weight in the power plant, since the internal combustion engines weigh only about half as much and occupy only two-thirds of the space of the steam engines and boilers, which saving may be profitably used for cargo. These advantages and others indicate that internal combustion engines using crude oil, especially those of the Diesel or semi-Diesel type, must inevitably be used to an increasing extent both for land and marine engines.

Although this country has lagged somewhat behind Europe in adopting large gas engines, there is evidence that this state of affairs will not exist very long, for a number of firms are now in the field building gas engines from 1,000 to 6,000 horse-power capacity. The uses to which these large engines are put are about equally divided between the operation of blowing engines for blast furnaces and the driving of dynamos for general power distribution. While the gas engine in the larger sizes is thus used extensively for the generation of electric light and power, a growing tendency is observed to use the gas engines direct as motors. A number of railroad and other machine shops have been equipped with moderate sized gas engines suitably located about the works, and in addition, thousands of horse power are used in the smaller sizes for a wide variety of purposes, including village waterworks, isolated lighting stations and manufacturing plants of all kinds.

The gas engine, usually adapted to consume gasoline or other oil fuel, has invaded the agricultural field and is being used to an increasing extent for a variety of purposes and in many forms, not the least important of which is the gas tractor, which is especially adapted to agricultural service in that it is conveniently mobile in the field and on the road, nor is it burdened with steam boiler nor gas producer.

In the field of transportation in addition to its use in the familiar automobile and motor truck, the oil engine constitutes the power plant in motor cars, in submarine vessels, in aeroplane service and also to a limited though increasing extent in railway motor cars.

Gas Engine Central Power Stations.— With the possibilities of high thermal efficiencies still higher development of cheap fuel gas processes may be expected that will bring the gas engine into close competition with the electric motor for power purposes, for it will doubtless be found that gas transmitted from a central gas-making plant at a manufacturing works into engines located nearby, combined with the recovery of by-products from the fuel will produce a very cheap form of power. Where large amounts of power are involved, as in the various electro-chemical industries, it is quite feasible to locate such works near a cheap fuel supply; in which case the recovery of ammonia and liquid hydrocarbons from the solid fuel, and the use of the residual gas in internal combustion engines combined with the generation and distribution of electrical energy should effect a material saving in the utilization of power over any existing method. It is not to be presumed that the gas engine will displace either the electric motor or the steam engine; each has its legitimate sphere of usefulness, and each will be more highly developed as the result of direct competition. Yet the economies already obtained indicate that the field of the gas engine will be gradually extended into that of the steam engine and the electric motor.

Steam Turbines.— Many of the questions involved in this consideration are at the present time in a transitional stage. The reciprocating steam engine has reached a high state of development, but it is not probable that it has attained its highest degree of perfection. While an economy of less than eight and one-half pounds of steam per horse-power hour has been obtained, even better results may be anticipated; the use of high pressure super-heated steam in compound, jacketed engines involves more perfect lubrication, and this may demand modification in existing valve types; however this may be, the outlook is promising for still higher efficiency.

Experiment demonstrates that both piston engines and steam turbines gain more in efficiency with a reduction in back pressure than they do with a corresponding increase in initial pressures; and further that steam turbines gain more than reciprocating engines. Superheat is another important element in steam engine and turbine economy. A gain in thermal efficiency very nearly proportional to the superheat is to be expected, but since maintenance costs increase rapidly beyond a moderate degree of superheat practice has confined itself to values of about 100°; occasionally going as high as 200° or 250° as the economic limit for reciprocating engines. These amounts depend upon the boiler pressure so that the initial temperature of the steam usually runs from 450° to 550° F. In steam turbines, owing to the absence of rubbing surfaces in contact with the steam, the superheat may be higher and temperatures of 650° F. are not uncommon. With back pressures reduced to less than one-half pound per square inch absolute which are now in use, it is reasonable to assume that any increased gain in efficiency in the future must result from higher initial temperatures and pressures. In this respect it is significant to note that steam boilers have recently been constructed for initial pressures of 400 pounds per square inch, and even 600 pounds pressure is being considered. At the same time high degrees of superheat have recently been adopted in special cases in which final temperatures of 800° F. and 1,000° F. have been attained. Whether this will mean cheaper power than can be obtained in other ways will depend upon many conditions. In any case, and especially with intermittent or variable loads, it is not so much a question of maximum efficiency as it is economy of operation.

From this point of view the present activity in the construction and development of the steam-turbine is of interest to engineers and power users. The steam consumption of a modern steam-turbine of moderate size compares very favorably with that of the better class of large reciprocating engines, but what is of greater importance is the evident superior steam economy under variable loads. The steam consumption per horse-power hour varies little from one-third to full load; at over-loads the economy, as shown by numerous tests, may be even better. This feature predestines the steam-turbine to the special field of electric lighting and power generation, where it must inevitably become a formidable rival of the larger-sized, slow-speed reciprocating steam-engine.

The turbine is not only able to utilize a fairly large fraction of the possible gain due to reduction of back pressure, but is generally much cheaper to build than piston engines, especially for very low back pressures which require in piston engines abnormally large low-pressure cylinders. Thus the practice has been established of using turbines for the low ranges of pressure in preference to piston engines, and of combining reciprocating engines and turbines to work together — the turbine taking the exhaust steam from the engine at whatever release pressure it is discharged, usually from atmospheric to 25 pounds absolute. This practice has been found especially valuable in adding capacity to existing overloaded reciprocating engines. In some cases the power has been doubled by this arrangement.

The high rotative speed of the steam-turbine is a prominent factor in favor of its adoption in connection with electrical generators, since the cost of the generator end of the equipment ought eventually to be very materially reduced; but for many lines of work the high rotative speed of the present types of steam-turbine is prohibitive, nor can it be adapted successfully to belt-driving, except by the use of gearing.

The economies already obtained with both the steam-turbine and the gas-engine have brought each into a prominence which is at least suggestive of the important developments that are taking place in methods of obtaining and using power.

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POWER OF ATTORNEY. See Attorney.

POWER OF DARKNESS, The (Vlast' t'my). Leo Tolstoy had made in his youth several abortive attempts at writing dramas, but he scored a remarkable success when, in the eighties, under the influence of his moral regeneration, he published his first drama, 'The Power of Darkness.' His intention was to strike terror into the hearers, not through the action of inexorable fate, but through the possibility of being engulfed by the Power of Darkness; hence the subtitle, «The bird is lost if its claw is caught.» This is illustrated in the case of the hero, Nikita, who pays no attention to the advice of his simple-minded father, the cesspool-cleaner Akim, but allows his wily mother, Matrena, who has been compared to Lady Macbeth, to kill Anisya's husband, in order that he may marry her and live at ease. The terrible scene in which Nikita, at the insistence of his mother and wife, kills his illegitimate child, by Akulina, had such a crushing effect upon audiences that Tolstoy was obliged to write a less terrible variant for its performance. The Divine voice in the tragedy is represented by Akim, who encourages his son to stand at the street corner and make his confession to the people and his peace with God.

Although passed by the press-censor, the dramatic censor prohibited the performance of the play. It was later performed first in private houses, and in 1895 in Suvorin's Theatre, where it produced a deep impression. However, on account of the surcharge of peasant details it was not a success at the Little Theatre or at the Moscow Art Theatre, where it was given later. In France it was performed as early as 1888 in Antoine's Theatre Libre and elsewhere, and in Berlin in the Deutsches Theater in 1900. It has been translated into English as 'The Dominion of Darkness' in Sergel's Columbia Library, Chicago 1890, and several times since by the translators of Tolstoy's complete works.

Leo Wiener.

POWER HOUSES. With the growth of electrical distribution, the generating station has become a highly specialized structure which demands consideration both from the electrical and mechanical viewpoints. In the first instance it presents peculiar requirements as to location, differing widely according to its purpose. Broadly, one may divide power houses into two general classes, those designed for the utilization of water power and those using heat engines as prime movers. The former are nearly always power transmission stations connected by high tension lines with the centre of distribution and not themselves burdened with direct distribution of energy to consumers. The latter are generally within the area of distribution, and the centres of distributing net works. In the cases where power is transmitted considerable distances from stations of the second class they are still generally to be regarded as distributing stations as regards the requirements of location.

Location.— The location of hydro-electric power houses is usually determined by purely hydraulic considerations. The area within which they may be economically placed is limited by the topography, and the chief requirements are as follows: First, the location must be such as to keep the power house free of floods under all conditions of stream flow. Second, within this limitation the location must be such as to utilize the maximum possible proportion of the available head. Third, in the interest of regulation the station must be placed so that it may be subject to the minimum variation of head. In plants working under high hydraulic heads, high enough to utilize impulse wheels conveniently, these conditions are easily met. At low heads there is often difficulty in placing the power house clear of floods and above any possible backing up of the tail water.

The location of a station driven by heat engines of one sort or another is usually kept as nearly as may be at the centre of the electrical distribution. Since for the delivery of any given load at a fixed percentage of loss the weight of conductor required varies directly with the square of the distance from the load, the reason for a central location is obvious. Assuming, for example, an electrical load uniformly distributed over a circular area, the most economical location of the power station, so far as the conductors are concerned, is at the centre. Transference of the station to a point at the edge of the area approximately doubles the cost of the distributing system. The causes which may justify removal from the central position are local conditions as to cost of real estate, of fuel and of water. The first item is part of the capital charge which may be taken as an offset to change in the cost of distribution; the last two affect the operating expense, and the change in these with change of location must be capitalized for comparison with the concurrent change in the cost of distribution.

Fuel.— Fuel is by far the largest single item of expense in ordinary electrical power production, and a power house must be so located, on a railway spur or waterway, that it can receive its supply and secure proper storage space without incurring serious charges for cartage or other handling of fuel. This necessity usually compels a location somewhat out of the centre of distribution. Water supply is more easily secured, but occasionally it becomes an important factor in location. In cases where the principal office of the power station itself is to furnish energy at high voltage for a distribution from substations, the cost of conductors is relatively a smaller consideration and commonly a location meeting the requirements just laid down can be secured without serious increase in the cost of the conducting system.

Equipment.— The electrical equipment of a modern power station usually consists of a small number of electric generators directly coupled to their prime movers, whether hydraulic, steam or gas operated. Except in small plants generators driven through intermediary belts, ropes or gears are rare, since these introduce added complications, cause some loss of energy, cannot well be used for large power, and serve no useful purpose of themselves, save now and then in giving the generators some specially valuable advantage in speed. In such case they should be used without hesitation if the conditions permit. The day of stations equipped with numerous small dynamos has passed, and for good cause, since the small machines are more costly and less efficient for a given total output, and they require also more space and more care.

Hence the number of generating units should generally be reduced to the minimum that will satisfy the following condition, viz.: that the total number should be such that one unit can go out of service without seriously overloading the others, dividing its load among them. Good modern generators usually are able to carry 25 or 30 per cent over their normal rated loads for some hours without serious heating, so that ordinarily four or five generators suffice. If the load upon the plant is normally moderate, two or three generators may serve admirably until such time as the normal full load nears the rated capacity of the machines.

In the case of a transmission or distributing network fed from several stations the total output rather than the individual output of the separate plants should be considered in determining the size of units to be used, for as regards reserve capacity it makes little difference whether it is in one location or another. Thus in some of the large hydro-electric networks 8 or 10 plants co-operate and the size of the units in each is determined not by the possession of a theoretical reserve capacity in a particular station, but by considerations of convenience, though some of the stations may have only one or two generators where such an arrangement suits the hydraulic conditions, and any station is called into or out of action by the load dispatcher just as if all the generators were concentrated under a single roof.

In steam-driven stations past practice has tended toward great aggregation of capacity, but more recently, since widespread distributing networks have become fairly common, the advantage from the standpoint of distribution of several generating plants has gradually been recognized and in planning these it is again the total capacity on the system which counts. The vital point is to avoid on the one hand putting too large a proportion of the possible output into a single unit, and on the other splitting the output into a number of units too small for the most economical operation. Stations with more than five or six generators are now generally relics of an early stage of design, except in certain cases of hydro-electric plants where the hydraulic conditions are such as to introduce the dilemma of choosing between relatively small units of normal design, or large units of special and sometimes disadvantageous design. Such cases arise in working at low heads where the available power from a single wheel or pair of wheels is comparatively limited. Cases may also arise in which generators for different purposes, as for general transmission, railway and electro-chemical service, may have to be installed in the same plant. In this case the number of machines for each use would be determined as if the other machines were located somewhere else. In plants including raising transformers the capacity of these is determined on the principles already laid down for the generators. Recent practice tends toward the installation of a single three-phase transformer or bank of three single-phase transformers for each generator without further subdivision. As between the two, practice is drifting toward the latter on account of the more convenient size of the separate units in large output and from the fact that in case of need two of them can be operated on open delta connection, thus giving an additional element of reserve capacity. Broadly, large stations should differ from small ones only in the capacity of individual units, so that if a 2,000 kilowatt plant is equipped with four 500 kilowatt units a 20,000 kilowatt plant would be equipped with four 5,000 kilowatt units and so on.

In either case the same allowance for reserve capacity would naturally be made, but evidently the larger plant would have the advantage not only of greater economy in the larger units but of reduced attendance cost per unit of output, and would also cost less per unit of output.

Large power plants then evidently can produce electrical energy at a lower cost than small ones. As the size is increased, however, the relative gain is diminished so that a size will finally be reached at which further increase in capacity ceases to be beneficial. Indeed since a very large station usually implies a large area served, the average distribution losses will be reduced by serving it from several interconnected power houses, so that the maximum economical capacity of a single power house is less than would be determined by considering only the effect of size on fuel and labor.

For example, if a certain considerable district requires 200,000 kilowatts, it is altogether probable that two 100,000 kilowatt plants will serve it more economically than a single gigantic power house and unless the district is of moderate area, four 50,000 kilowatt stations would probably do even better, provided they could all be well located. In other words a power plant of 50,000 kilowatts or thereabouts comes so near to giving maximum economy of operation that the difference is easily offset by lessened losses in distribution. The only cases in which size may be economically increased without limit are those in which the plants must for one reason or another lie far without the area served, as in great hydro-electric plants like those at Niagara, or in plants using coal at the mines for transmission of power on a colossal scale.

In any power house adequate provision for reserve capacity evidently can be most easily made if the equipment throughout is of a single kind so that everything may be as far as possible interchangeable. Similar units of uniform size are, therefore, advisable throughout the entire plant unless there is some good reason to the contrary.

The equipment of a power house may be divided into four parts: the prime movers, the electric generators, the accessory apparatus, and the switchboard, from which the output is regulated and distributed. The power-house structure must be planned for advantageous location of all of these and in addition, if steam is the motive power, there must be ample provision for the storage of fuel.

Design and Arrangement.— In point of design hydro-electric power houses present by far the simplest problem. In these the prime movers are the water wheels, which are relatively simple and compact, the generators are directly coupled to the shafts of these, and the output is delivered to a small number of lines so that the switchboard is relatively simple. As most such plants are for high voltage, the power house must often provide place for the transformers which raise the voltage from that of the generators to that of the line. Less frequently such transformers are found in steam-driven plants.

Structurally the ordinary power house consists of two parallel halls with a common dividing wall, one containing the generating units, the other water wheels or boilers as the case may be. The generator room contains or has annexed to it space for the switchboard connections and for the transformers, if any, while the boiler or wheel room has annexed to it space on the one hand for fuel, on the other for the hydraulic connections. Usually the plant comprises only a single story, although more rarely ground space is gained by superimposing some of the parts.

One may now pass to consideration of the concrete arrangements usually adopted, the hydro-electric case being taken up first, as the simpler in design.

Fig. 1 shows the small plan of a typical hydro-electric power station using as prime movers water wheels under high head. Here A is the receiver terminating the supply pipe and provided with branches to the several wheels. At very high heads these branches are sometimes made farther back, spreading finger-wise from a terminal chamber to secure a straighter run to the wheels. B, B, B are the water wheels, directly coupled to and on the same level with the generators C, C, C. The pipes from the water supply enter the lower part of the wheel cases and discharge into the tail race below the power-house floor. The wheel gates are controlled by the governors D, D, D. The generators are revolving-field, 400 kilowatts, three-phase machines, giving 13,000 volts at the terminals at 500 revolutions per minute. Their fields are excited by two 25-kilowatt direct-driven exciters, E, E, each of which is regulated by a separate hydraulic governor. The switchboard is located on the floor level at F, and the line wires leaves the power house just above and behind the switchboard. Room is provided for a fourth generator and a traveling crane running lengthwise the power house is available for handling the machinery if necessary. The material of this power house is brick, on concrete foundations, with a steel truss roof covered with reinforced concrete slabs and then with roofing felt and asphalt, as the location is in a cold climate.

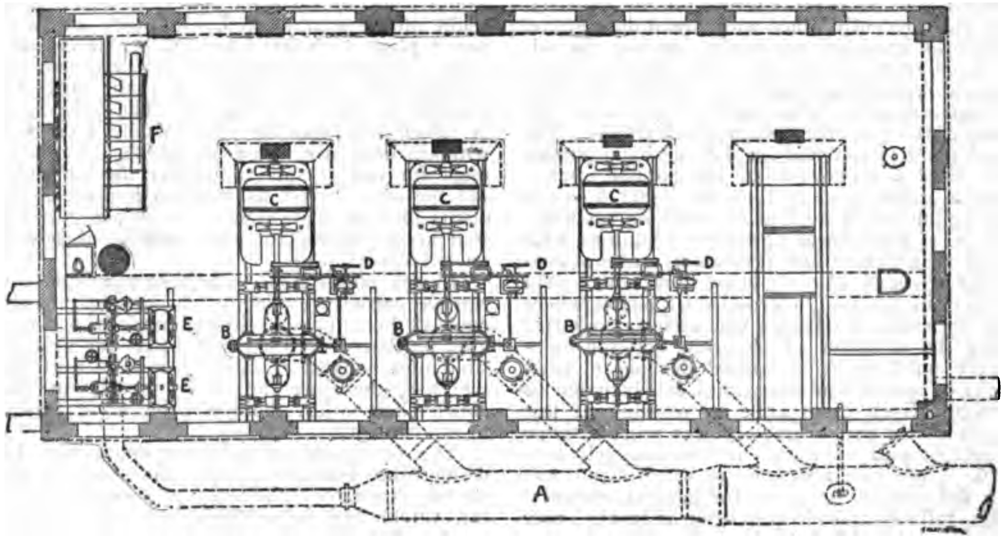

FIG. 1.

The design here followed is thoroughly simple and normal. At higher hydraulic head the somewhat unusual turbines here used would be replaced by impulse wheels in the same situation; at lower head by considerably bulkier turbines, which would require a wider tail race and power house for their accommodation. In this case the inner tail-race wall would usually carry a partition wall separating the wheel room from the dynamo room proper and provided with water-tight fittings for the turbine shafts to pass through.

In case raising transformers were to be used in such a plant the generators would be for perhaps 2,300 volts, the switchboard would preferably be turned around, facing the exciters, and the station would be extended far enough to the left of the cut to accommodate the transformers and the necessary accessories; or, if more convenient from the nature of the ground, space could be gained by widening the power house enough to accommodate the row of transformers. The size of the power house of Fig. 1 is about 40 feet by 85 feet and slight modifications of this simple design serve well up to very much larger capacities. In case the necessary width becomes too great to be conveniently covered by a single roof, separate roofs are placed over the wheel rooms and generator rooms and in mild climates the wheel cases and tail race may sometimes be left uncovered.

In case of hydraulic plants operating at rather low heads one is often driven to the use of vertical shaft turbines, which results in a somewhat different arrangement of power house from that shown in Fig. 1. In such cases the forebay usually comes fairly up to the power-house wall instead of the water being received from a reservoir at the end of a pipe line. The generators like the water wheels are vertical shaft machines, the weight of the revolving fields being carried by a combination of water pressure and step bearing. Fig. 2 shows a cross-section through one of the four 6,000 horse-power units in a recent hydro-electric plant operating under a head of 49 feet. The design is an interesting one from the fact that the wheels have but a single runner which operates at 116 revolutions per minute, while the spiral wheel case and its entrance and the discharge draft tube are smoothly molded in the concrete foundation of the power house, which is really built as a sort of annex to the massive forebay wall, and in the monolithic foundations, of which the wheel cases and the water channels are a part. The bus bar and switchboard galleries occupy in this structure their wonted position, but the power-house interior is otherwise very simple, containing merely the four great vertical-shaft units rising above the floor over the wheels, the water-wheel governors and a few other auxiliaries. This power-house design is the latest type of those designed for the utilization of large powers at fairly low head. The hydraulic construction has the advantage of combining very high efficiency with compactness and extreme simplicity. It is really a power house built around, instead of containing, the hydraulic units.

It is necessary even in hydraulic plants to make the power station as nearly fireproof as possible and hence brick, steel and concrete are the most suitable materials of construction. Wood, even if treated by some fireproofing process, should be sparingly employed. For floors, concrete, reinforced when necessary, is probably the best material. The transformers and switchboard are the danger points, from the standpoint of fire risks. The former should be placed so that even if they burn out no exterior damage will result. If, as is usual in high voltage plants, they are oil-insulated, provision should be made for disposing of the oil harmlessly in the rare case

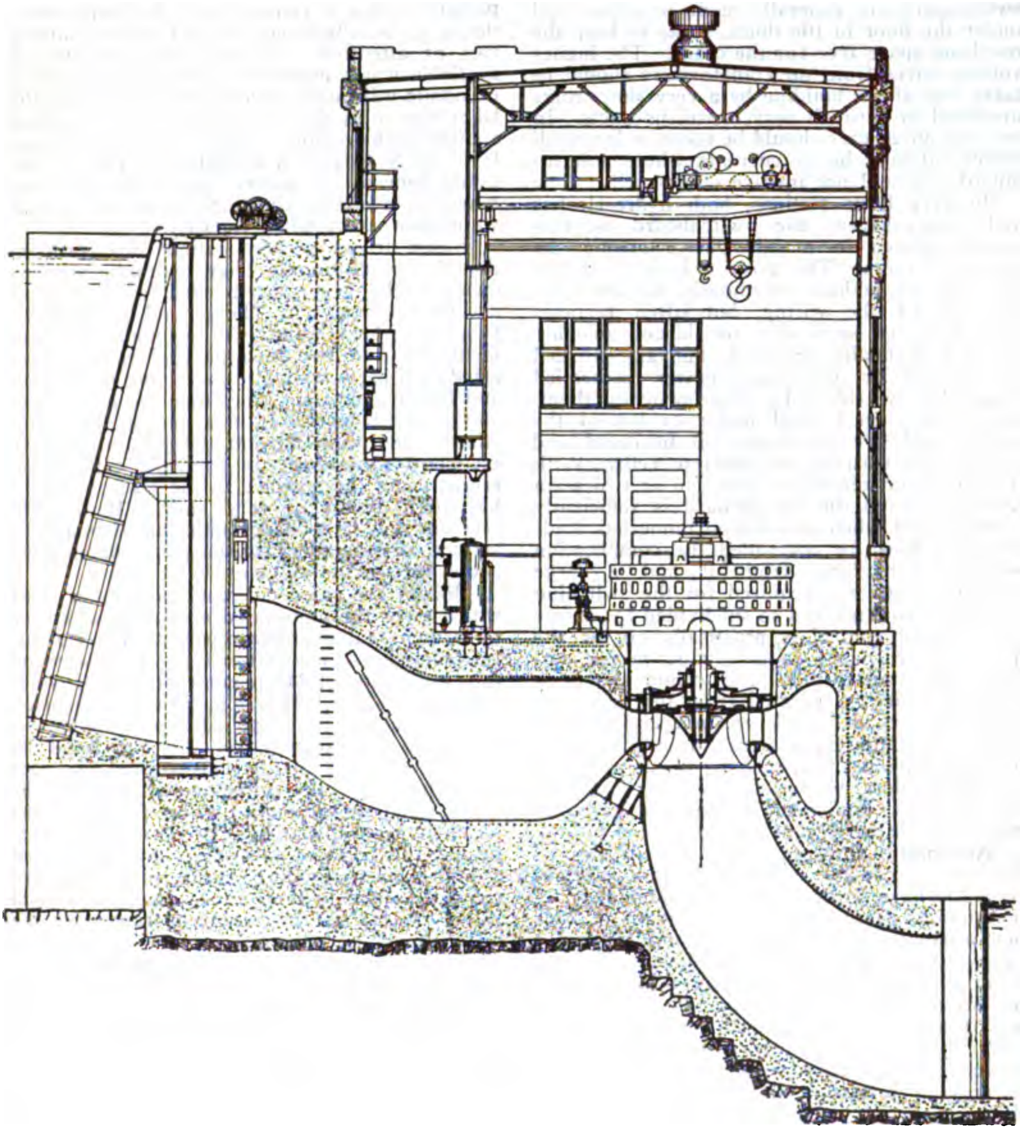

Fig. 2.— Section through power house No. 2, Appalachian Power Company, showing 6,000 horse-power hydraulic turbines and generators in place.

where it ignites from an extreme short-circuit. Transformer oil is very difficultly inflammable, but it can be fired, and oil transformers should be guarded by pits with drains, so that the oil may not run about if it escapes from the cases. Generally the transformer cases are provided with drain valves from which the oil can be quickly run off outside the station.

The connections between generators and switchboard are generally made by cables laid under the floor in tile ducts, so as to keep the overhead space free for the crane. The higher voltage wires from the transformers should be taken out of the building by a very short route overhead or through very capacious ducts. In any case great care should be taken to locate all cables carrying heavy currents where a burn-out of one will not involve others.

In very large stations, both hydro-electric and steam-driven, the switchboard is frequently placed in a gallery overlooking the generator room. This position is in itself undesirable as adding enormously to the complication of the wiring, but often becomes advisable. In such case the larger switches are not manually operated, but are worked by electric or pneumatic power controlled from the switchboard. The switches themselves are then located under or behind the gallery and are commonly oil insulated and enclosed in masonry or concrete cells. With three or four generators and one or two main lines to be fed the switchboard is sufficiently complex, but when in addition numerous feeding lines must be controlled the complication becomes something frightful and a large amount of space is required for the switching apparatus, so large and so subdivided for safety that manual control is practically out of the question. In large high voltage power stations the transformers are commonly in a building entirely separated from the main station and provided with an independent high voltage switching equipment, a procedure which probably adds nearly as many risks as it avoids. On the whole a plant with few units and relatively simple equipment is likely to give the most reliable service at the lowest cost.

Automatic Stations.— The possibilities of the remote control switching system just referred to have borne fruit in hydraulic generating stations partly or wholly automatic in their performance. If the switching of a generator can conveniently be accomplished, as is the case, from a distant part of the power house without seeing the apparatus controlled, the working of which is signaled back by electrical telltales, then it is evidently possible to work a wheel gate or a main switch or any other apparatus in precisely similar fashion from a distance of rods or miles. There have, therefore, been introduced auxiliary generating stations started and stopped from the main switching station and regularly operated without other attendance than the occasional visit of an inspector. The generators used in such case are commonly of the induction type, which do not require separate excitation by direct current and are consequently simpler to operate without attendance. When desired to start the station the motor-driven wheel-gate is opened by remote control of the circuit and the subsequent necessary operations of switching the generator fully into circuit are performed either by other remote control apparatus or by a drum switch thrown into operation when the generator is at speed and performing the necessary switching operations in their proper sequence. In stopping the plant the same operations are gone through with in reverse order. Most stations of this type are of relatively small power and contain but a single generator, but the system is important in that it enables small hydraulic privileges to be effectively utilized without undue cost of attention. As the great majority of available water powers are of modest capacity economic utilization depends upon lowering the labor factor in the cost, which the generating station with remote control effectively does. It is likely to play a considerable part in the establishment of power networks utilizing, wherever available within the territory served, water powers of small capacity.

Steam-driven power stations are proportioned very differently from hydraulic stations owing to the large space needed for the boilers and their accessories. The general layout, however, is quite similar, the common arrangement being in two long parallel rooms separated by a party wall, one containing the boilers and boiler equipment, the other the generators and prime movers. It is a curious fact that whereas the prime movers and generators have increased enormously in available capacity in recent years the advance in the size of boilers has been relatively very slow. It is only recently that large boiler units have come into service, despite the fact that tests upon them show very material gains in efficiency.

Boilers are rated conventionally on a basis which gives the uninitiated no notion whatever as to their real steaming capacity. The canonical boiler horse power has long been based on the evaporation of 34.5 pounds per hour of water from and at 212°. This nominal rating requires, when a boiler is to be applied to a prime mover, wholesale modification, on the one hand by reason of the actual steam consumption per horse power of the prime mover, and on the other hand on account of the fact that the steam is generally at high pressure and superheated. In point of fact the steam capacity of a boiler in a modern steam plant may be counted as two to three times the conventional rating so far as the actual operation of the prime mover is concerned.

But, even so, the boiler capacities have grown much more slowly than the capacities of the steam engines or turbines, the latter being almost invariably used in plants of any size. It is, however, a fact that boilers of large capacity may be counted on for considerably higher efficiency than those of small capacity, as in many other cases, so that larger and larger units are quite certain to come into use. At present boilers of more than 1,000 horse power nominal rating are rather unusual, although units of more than double that size have been successfully used for some years past. The chief difficulty in employing very large boiler units is in adapting the setting to withstand the extremely high furnace temperatures which result in added efficiency. It is usual, therefore, to find each large prime mover in a modern station supplied with steam by a group of four or more boilers, a number which a few years back would have been doubled.

There is a collateral advantage in thus subdividing the boiler units, inasmuch as the boiler is the part of a steam plant which requires, probably, the most frequent repairs, and there is some advantage in having enough units for each prime mover group so that one can be cut out without seriously lowering the capacity, inasmuch as a boiler can at a pinch, particularly by help of forced draft, be driven temporarily 30 to 50 per cent above its working rate. A single boiler group of three or four units can readily be made an independent source of steam supply for its prime mover under ordinary circumstances. Generally, however, the steam piping in a modern plant is so arranged that in case of withdrawing a single boiler from service its place can be filled from steam from the general supply without exceptional forcing at any point.

here shown are almost universal, as is the use of mechanical stokers for feeding the boilers, which are almost invariably of the water-tube type. This particular boiler plant delivers steam at 200 pounds' pressure and 160° F. super-heat, which is a fair example of present practice. There is a strong tendency, however, toward the use of higher pressures and super-heat in the interest of economy.

The generators in this instance are for 6,600 volts, a figure convenient where there is to be local distribution beside possible feeding of transmission lines and which is besides a convenient voltage in the design of large generators. Smaller machines are often wound for 2,300 volts and 6,600 is rarely exceeded. The reciprocating engine has practically passed out of existence in large electric generating plants owing to the lower cost, greater compactness and higher efficiency of the turbines, particularly at loads below the normal. The boiler units here employed are of 1,050-rated horse power each and can readily be forced to three times their nominal rating which is, as in the case of all boilers based on a conventional steaming capacity, long obsolete.

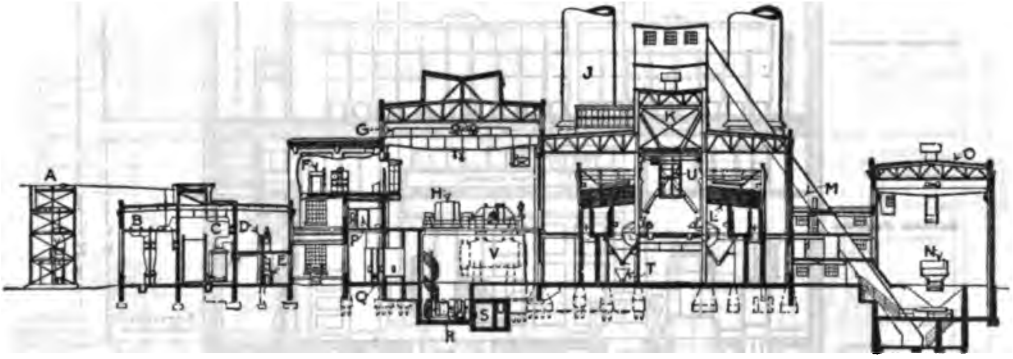

FIG. 3.— A — 42,000-volt arresters; B — 42,000-volt reactance circuit breakers; C — three 4,000-kva. transformers per generator; D and E — 6,600-volt circuit breakers and bus structure respectively; F — control room; G — 50-ton crane; H — 12,500-kva. turbine-generator; J — smokestack; K — 420-ton coal bunker; L — 1,050-hp. boilers; M — 60-ton elevator; N — coal cars; O — coal shed; P — lavatory; Q — humidifiers for ventilating air; R — condenser circulating pump; S — cooling water tunnel; T — ash car; U — 5-ton lorry; V — condenser.

Fig. 3 shows in elevation the layout of a typical modern steam plant of fair size designed for feeding high-tension lines. It includes a boiler room with typical provision for receiving and distributing the fuel, a turbine room parallel thereto containing the generators, with adjacent provision for switchboard transformers and auxiliary apparatus, while next to the boiler room is a coal shed for the reception of fuel. This particular plant is planned for an ultimate capacity of 75,000 kva. in six 12,500 kva. generators. The location of the equipment is clearly shown in the cut. In larger plants the turbo-generators often run to 20,000 or 30,000 kilowatt units and occasionally higher. At the present time as here shown these turbo generators are built with horizontal axis, the vertical type of a decade since being now obsolescent. Very commonly the coal shed with its track for the reception of coal cars is replaced by a storage yard equipped with automatic conveyers for the maintenance of a large fuel supply, and crushing apparatus for dealing with run-of-the-mine coal is a not uncommon accompaniment. In small plants the transformers and circuit breakers would often be installed under the switchboard gallery instead of, as here, in an adjacent building.

The capacious coal bunkers above the boiler room with distributing apparatus similar to that

Each turbo-generator has its own bank of boilers, but the piping is so arranged that one set of spare boilers is sufficient for the entire plant. At Q will be noted an equipment for purifying and cooling an air-blast for the artificial cooling of the turbo-generators. As the size of such generating units has increased artificial cooling has been very generally adopted, the air being forced through the ventilating slots in the machines. The capacity of the individual boilers here noted is now a common one in plants of fair size, such boiler units having replaced very extensively those of a few hundred horse power generally in use until very recent years. In larger plants boiler units up to and exceeding 2,000 nominal horse power have been introduced to material advantage in economy. In many plants the familiar tall stacks are replaced by rather short ones supplemented by forced draft. This arrangement is not particularly advantageous in plants working at moderate and fairly steady load, but gives great capacity for forcing the output when abnormally heavy peak loads have to be dealt with.

As steam turbines for efficient operation demand a rather high vacuum, 28 inches to 29 inches, they are usually fitted with highly-developed surface condensers and the power required for delivering water to these and for other auxiliary purposes is considerable. One of the moot points in station design is the source of this auxiliary power, whether it should be derived from steam turbines or from electric motors operated from the generating system. Practice is about equally divided in this matter with a frequent tendency to adopt a combination of the two systems. It will be noted that the switching apparatus in this typical plant is somewhat intricate and occupies considerable space. This arises from two causes, first, the absolutely large amount of switching apparatus required, and second, from the fact that it is desirable and usual to install high-power switches and circuit breakers in independent concrete cubicles, from which a burn-out will not extend. As plants have increased in size the switching problem has become a very serious one. It is usual and sometimes necessary to operate all the generating units in parallel. In this case any unit which is the victim of a short-circuit may receive the aggregate output of all, so that each main protective switch has practically to be able to handle successfully the whole output of the station. In long-distance transmission plants this difficulty is often minimized by putting the high-tension transformers in parallel only at the far end of the line, but within the station and in ordinary distribution plants the difficulty remains. Hence the switchboard equipment increases in relative cost and generally in complication, with the size of the station, particularly if as usual the number of feeders is greatly increased. In view of this switchboard apparatus and connections should be protected with the utmost care, special pains being taken to locate cables and apparatus so that injury to one may not involve others and this injunction extends to all apparatus which from its connections can conceivably cause a short-circuit. It has repeatedly happened that large stations have been put out of action by apparently trivial accidents occurring at an unexpected and unprotected point.

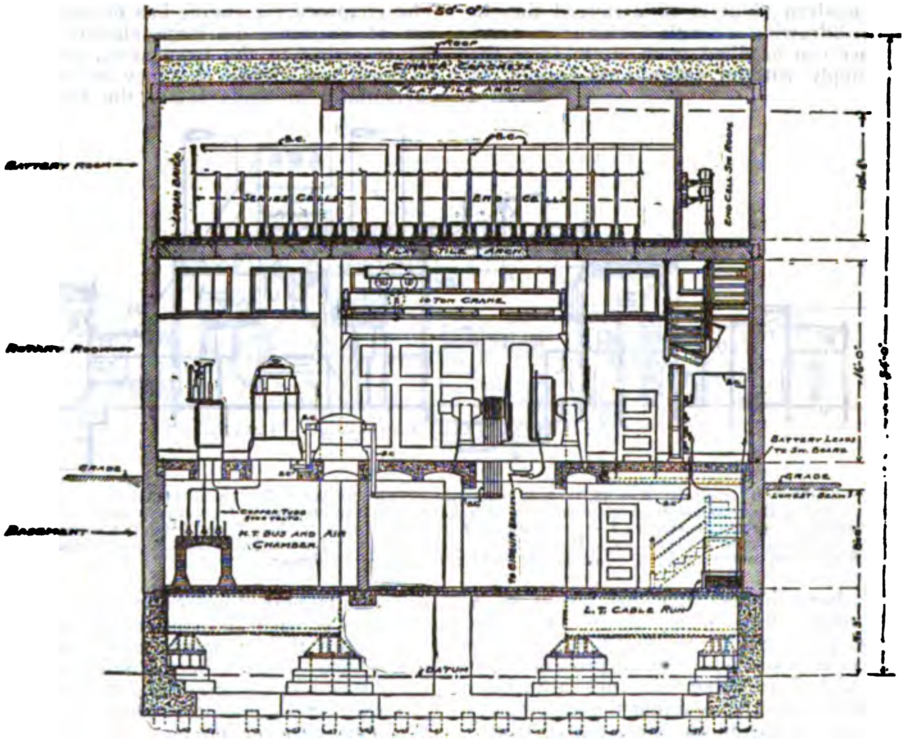

Fig. 4.

The fundamental principles at the basis of modern station design are so to arrange the apparatus that nothing need be done by manual labor which can better be done by mechanism, and that no heat shall be lost which can be made to serve a useful purpose. In the station of Fig. 3, for example, the fuel is dealt with mechanically from the time it drops by gravity from the cars to the moment when it drops as ashes into the ash cars beneath the grates, save for such attendance as is necessary to see that the mechanical stokers are functioning properly and to lend what little aid may be needed. The steam piping is relatively short, simple and well jacketed, the surface condensers are immediately beneath the turbines and the waste exhaust from the auxiliary turbines goes to heat the feed water.

Sub-Stations.—An account of power houses would be incomplete did it not take notice of sub-stations. The modern power house is almost always fitted with alternating current generators which transmit current either for general distribution or for conversion into direct current for supplying electric railways or the old direct current lighting systems. Such conversion must probably be regarded as a makeshift, but at present a necessary one. The high voltage current from the power house is transmitted through cables or over aerial lines to the sub-stations, and there the voltage is lowered by reducing transformers to the amount appropriate for the synchronous converters. The sub-station must, therefore, accommodate the reducing transformers, the converters, regulating apparatus, switchboards for both alternating and direct currents, and sometimes a storage battery and its accessories. The structure, therefore, becomes practically a power house for general service, less only the prime movers. Fig. 4 shows in elevation a sub-station for city lighting and power service which is a masterpiece of compactness. It is a modern steel building two stories above grade and with a basement for the cable entrances and exits. The main floor contains, as Fig. 4 shows, arranged in order, the high-tension bus and main switches, the three-phase transformers, the regulators, and the rotary converters, of which there are four, each of 1,000 kilowatt capacity. The same room contains the booster set for charging the batteries at a variable voltage somewhat higher than that of the rotaries, and the switchboard, also a blower set for ventilation. Large apertures are left under the rotary converters and transformers so that a liberal air supply may be drawn in from below and exhausted by the blower. The second floor contains the storage batteries and their special switching arrangements. On account of possible leakage of acid from the batteries the floor construction is peculiar. The basis is tile arch over steel beams. Then comes a layer of concrete coated with asphalt, then a floor of hard-baked brick, glazed all over, laid with narrow interstices which are finally filled with hot asphalt.

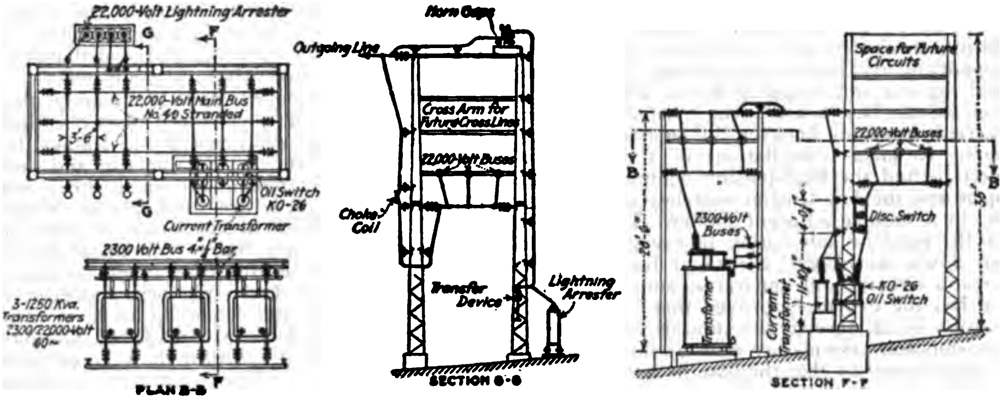

Fig. 5.

Sub-stations for railway service do not so commonly have the storage battery, and are generally less compactly arranged, but after about the same general plan. The sub-station shown here covers only 3,150 square feet for its 4,000 kilowatts capacity. Ordinarily the switching arrangements in a sub-station are so intricate as to require a rather liberal allowance of space. The same principles of location and subdivision of units hold for sub-stations as for power houses in general, with the advantage that the location is not dependent on water and fuel supply. Sub-stations for the receiving ends of power transmissions for general service differ from those just described in the lessened importance of synchronous converters. The ordinary distribution from a high voltage transmission service is very largely by alternating currents, and is accomplished by substations designed accordingly. The high voltage current is received in large reducing transformers which in number, size and location are to be treated as so many alternating current generators fortunately exempt from the necessity of rotation. Regulating apparatus is an important feature of stations of this class, and being inductive can be applied with very small loss of energy to the exact regulation of voltage on individual feeders.

For arc light service constant current transformers are very widely used, taking energy from the lower voltage side of the reducing transformers. This service requires a special switchboard, and is generally set apart in the sub-station. Owing to the absence of rotating machinery in any considerable amount the sub-station for general service is compacter and requires less in the way of foundations and special construction than the sub-station of Fig. 4. Otherwise the principles of location and design are unchanged.

Out Door Sub-stations.—The needs of high voltage transmission have evolved in recent years an interesting and important form of sub-station which is coming into very wide use. One of the main difficulties of high tension practice is the large space required for switching apparatus and the great difficulty of getting high voltage wires into and out of buildings while retaining adequate insulation. The result is that a sub-station building and equipment rises to very burdensome cost in case the output required is not large. There has, therefore, been evolved the outdoor sub-station derived by natural process of growth from the transformer mounted on a pole, and supplied with the necessary auxiliaries for protection and switching. To meet these requirements weatherproof apparatus has been designed which can be safely left in the open under all climatic conditions. The common form taken by the outdoor sub-station is a concrete platform to bear the weight of the transformers and above it a quadrilateral of steel or wooden poles braced together and carrying switches, cut-outs and other auxiliary apparatus, as well as serving to support the incoming and outgoing circuits. In stations of the larger capacities electrolytic cell or similar lightning arresters, and oil switches form part of the platform equipment, while in the smaller stations air-break switches with very long swing and protected by horn-gaps, and horn-gap lightning arresters often take the place of the more expensive apparatus. Fig. 5 shows in section and plan a typical station of this kind and of medium capacity. Here the transformers are of the usual oil-filled type, cooled by natural draft, and the lightning arresters are of the electrolytic form installed on a platform by themselves. The switching equipment is of oil switches carried on a platform like that which supports the transformers. Above these concrete bases for the heavy apparatus rises a latticed steel structure well braced together and supporting the busses, transformer connections and ingoing and outgoing lines. These last as well as the busses are borne by disc insulators carried in tension between the supporting members. In larger installations it is not uncommon to find the high-tension equipment in the open and the low-tension switches and apparatus in a suitable adjacent shelter. The purpose of the outdoor sub-station in every case is to cut down the heavy expense of housing high-tension circuits and apparatus, and so successful has the expedient proved that a large proportion of all service sub-stations on the great transmission systems are now of this form. It is needless to say that they are protected against interlopers by thorough fencing in, and are otherwise treated with the respect due to their voltage.

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POWER SIGNALS. See BLOCK SIGNAL SYSTEM.

POWER TRANSMISSION. It is rarely convenient to develop power at exactly the point where it is to be utilized, and hence the necessity of devices and systems for conveying it from place to place without loss, or with the minimum of loss. These systems of power transmission separate naturally into two groups: one in which the motion produced by a power is transmitted mechanically; the other where the power generated by one engine is used to operate another engine, the motion developed by the second engine being employed in work. To the first group belong the mechanical devices known as shafting, belts, chains, rope and cable drives, friction gearing, toothed gearing, link work and the like. To the second group belong the transmissions of power by compressed air, steam, hydraulic pressure and electricity.

Shafting.— Between the different parts of a given machine, or of a given mill, the transmission is often effected by means of a rotating shaft, which is subjected to a torsional moment. In mill work the shaft is rigid, and is made of solid steel, or of steel tubing; while in small machines (as in dental drills and the like) the shaft is often flexible, so that the point of application of the power can be varied at will, without disturbing the source from which the power is drawn. In mill practice it is essential that the alignment of the shafting shall be as good as possible,— that is, that the centre line of each shaft shall be as nearly straight as it can be made. It is also essential that the "journals," or bearings which support the shaft, shall be properly designed and well lubricated. If attention is paid to these points, transmission by shafting may be quite efficient; but if the alignment is poor, or the journals are poorly designed, or the lubrication is inadequate, a great deal of energy may be absorbed by the shaft, and dissipated in the form of frictional heat. In transmission by shafting, the speed remains invariable, that is, that of the engine as controlled by its governor, and if (as is usually the case) a change of speed is desired, it must be effected by the use of gearing or belting, or some similar device. The more common practice, however, is to transmit the engine power to one or more jack-shafts where it may be divided as desired, and distributed to the several machines where it is utilized.

Belts are employed more commonly than gearing, for transmitting power from one shaft to another. They are generally of leather, but rubber belts are in considerable use and belts of canvass are common for small farm machines. Leather belts are single-ply or double-ply. The latter cost about double as much as the former, but are more economical in the long run as they deliver four times the power during life. The double-ply belt, however, is much less pliable, and cannot be used on small pulleys. Rubber belts are made of alternate layers of rubber and cotton duck compressed into a solid band. They are more resistant than leather to heat, cold and moisture but are easily ruined by lubricating oils and greases. If kept strictly clean they will long outlast leather, and are considered to give a better grip on the pulleys. Canvas belts are cheap, and are readily affected by the weather. They are much improved by waterproofing paints and dressings. Steel belts have been used with success. They are simply flat bands of tempered steel. For an equal power they are about one-fifth the width of a leather belt, and show only one-tenth the slip. They are run at speeds up to 10,000 feet per minute. The resistance of a belt to slipping is independent of the width of the belt, so long as the total stress upon the belt is constant. It depends chiefly, in this case, upon the arc of contact between the belt and the pulley; and a belt will slip just as readily upon a pulley four feet in diameter as upon one that is two feet in diameter, if the arc of contact (measured in degrees) is the same in both cases, and the surfaces of the two pulleys are in the same condition. The laying out of a successful system of belting, for use in mill work, calls for practical experience with belts, since it must be admitted that the formulæ that have been given do not correspond with experience. The performances of belts have made all the carefully devised rules seem ridiculous. There are too many variables in the problem. In most cases it is customary to make a computation according to Webber's rule for ordinary leather belting of single thickness: A belt one inch wide will safely transmit one horse power, when run at a speed of 600 feet per minute; and the power transmitted will be proportional to the width of the belt, and to the speed at which it is run. This rule gives no information with regard to the proper tension; but it implies that the tension may be safely increased until the belt actually does transmit the computed horse power. For efficient operation, that is, the economical transmission of the power, the driver and driven pulleys should not be too close together. A large percentage of power is transmitted if a distinct sag in the driving side of the belt is arranged for. For narrow belts the pulleys should be at least 10 to 15 feet apart and the sag about 2 inches; and for wide belts from 20 feet upward and the sag up to 5 inches. Where the distances between shafts are necessarily less than these either rope or chain drives may be more effectively employed. The angle at which belting is placed with reference to the horizontal should never exceed 45 degrees. With a very stiff belt vertical belting is practicable if necessary. In placing belt pulleys on the jack shaft they should be so arranged that the pull alternates in different directions. Unless absolutely impossible, the motion should be from the top of the driver to the top of the driven pulley: in this case the sag increases the arc of contact. The pulleys should be as large as practicable to lessen the abruptness of bending in the belt but the speed (except for steel belts) should not exceed 4,800 feet per minute. If the pulleys are faced with leather, the tension of the belt may be reduced, with a larger transmission of power and an increased durability of the belt. The greatest efficiency in belt transmission of power is secured with narrow belts on large pulleys, run with low tension at high speed (4,000 feet per minute).

Rope and Cable Drive.— Rope drives are used where the shaft centres are too close together or too far apart for the economical use of belting, and generally where very large power is to be transmitted. The faces of the pulleys are scored with deep grooves narrow at the bottom, so that the rope will be gripped by the wedging of the sides of the groove. The width of the pulleys is governed by the power to be conveyed, ranks of 30 ropes being not uncommon for large powers. There are two methods of fitting out such a drive: the English and the American. By the former method each complete wind of the rope is individual, and is spliced in its place. In the American system the entire drive consists of one continuous rope, with but one splice. The slack of so long a rope is large, but is taken up by a tension carriage around which the rope makes a single turn. After a new drive has run a few minutes all the slack has been gathered upon this carriage, and the tension of all the coils of the drive is uniform, and is kept so by the tension regulator. In the English drives, on the contrary, it is rarely that any two coils are of the same tension, and a lack of efficiency results. The speeds at which rope drives are run vary from 2,000 to 4,000 feet per minute. They are most effective when run under full load. The rope used in such drives is preferably a four-strand rope of long-fibre Zebu manila twisted upon a core. This rope is not only soft and pliable, but very durable. Cotton ropes have made remarkable records in some cases. In a certain Scottish cotton mill a rope drive of 24 cotton ropes one and three-fourths inches in diameter ran continuously at a speed of 4,400 feet per minute for 26 years without repair. This drive transmitted 826 horse power from a driving pulley 28 feet in diameter.

Wire ropes or cables are useful in very long horizontal transmission. They work acceptably up to 6,000 feet, if relay pulleys are provided at least every 500 feet, transmitting about 80 per cent of the power. They are generally woven of six strands upon a cotton core, each strand being a cable of from 7 to 19 wires of charcoal iron or low steel: the 7-wire cables make a stronger rope, but less pliable. On account of its great liability to rust a wire cable used in power transmission is usually treated with boiled linseed oil, which has also the effect of improving its grip on the pulleys. The pulleys for wire cables should have a leather bed in the bottom of the groove to save wear of the cable.

Chain Drive.— For speeds of less than 1,000 feet per minute the chain and sprocket drive is highly efficient. The disadvantage with it is that the teeth of the sprocket wheel become worn so that the pull is not evenly distributed upon the wheel. In extreme cases the entire pull may fall upon a single tooth. The sprocket wheel should never have less than 12 teeth. The usual top limit is 60 teeth. This form of drive is particularly adapted to situations where the driving shaft and the driven shaft are necessarily close together. For very heavy powers the gear-chain is effective. It is so constructed that the ends of the links form a series of cogs on the inner side of the chain-belt, to engage with the cogs of a broad spur-geared wheels. Because of their noiseless running these chains are sometimes called "silent chains."

Friction Gearing.— In some circumstances friction gearing is desirable, but as it depends for its efficiency upon strong pressure, with the excessive strains which accompany it, this form of power transmission is generally avoided. Where used the driving wheel is usually of iron and the driven wheel of leather, or faced with leather. It has been found, however, that the friction of aluminum on leather is 40 per cent greater than that of iron on leather.

Wheel gearing is discussed at length in a special article under that title, to which the reader is referred. This form of power transmission is effective in overcoming resistances in which belts, ropes and chains would be insufficient. The efficiency of toothed gears ranges up to 98 per cent when the teeth are comparatively small and the speed low, or very fast, medium speeds showing a lower efficiency. The breaking pressure on the teeth of toothed gears increases up to a certain speed, and above that speed decreases.

Link work includes the mechanical devices known as cams, eccentrics, cranks, connecting-rods, levers and the like. They serve to transmit motion from one part of a machine to some other part.

The second group of power transmissions depends upon the elasticity of fluids. Air, steam or water are put under pressure, and this pressure is available for work at the farther end of the pipe-line which confines and conveys the fluid. In the case of electricity the condition is somewhat different, but is comparable to a hydraulic current flowing in a pipe.

Compressed air (q.v.) is employed in the transmission of power in many cases, especially in the operation of rock drills, and in mining generally, the air serving, in such cases, not only to operate the machinery, but also to aid in the ventilation of the mine. While the efficiency of the mains is 98 per cent that of the motors varies from 40 to 67 per cent. The compressed air may be delivered to the point at which the power is wanted by means of pipes directly from the compressors, or it may be stored at high pressure in tanks, from which it is drawn as wanted. For example, in mining locomotives are used which derive their power from large tanks of compressed air that take the place of the ordinary steam boilers of other locomotives; these tanks being charged at convenient points along the line of travel. Steam is used in the same way but with much less efficiency as enormous amounts of heat are lost from naked steampipes and they are very rarely insulated. Power is also transmitted hydraulically, when, as in cranes, presses and elevators, it is desired to exert great force in some slow-moving piece of machinery. In London and other European cities there is a regular public service of water under high pressure for use in small shops as a cheap source of power.

A great deal of attention has been given, in recent years, to the economical transmission of power by electricity, and the various problems that are involved have been solved so satisfactorily that enormous quantities of power are now transmitted electrically, in some instances to a distance of upwards of 200 miles. The mechanical energy that is to be transmitted is first converted into electricity by means of a dynamo; and the electricity thus generated is led along a conductor (usually of copper) to the point where the power is to be used, it being there reconverted into mechanical energy by means of electric motors. In certain shops and mills, the power is transmitted in this way from the engine room to the various machines that are to be operated, each machine being provided with its own separate motor. Installations of this kind are especially successful when the work is of such a nature that the machines are idle for a considerable part of the time, because there is no loss, in electrical transmission systems, when the circuit is interrupted and no current is flowing; whereas in a mill that is fitted up with shafting and belts the shafting runs all the time, and the losses due to its friction go on all the time, whether the machines are running or not. The use of individual motors, as described, is also advisable in plants where the machines are run at high speeds, since the desired speeds can be attained electrically, without the losses incident to the use of pulleys and belts, of trains of gears, or any other method of direct mechanical multiplication.

In the transmission of power by electricity to considerable distances, the chief losses are those due to direct leakage of electricity along the line, and to the dissipation of energy in the form of heat in the conductor. The losses due to the former cause can be kept down to a reasonable limit by paying proper attention to insulation, though the problems that are here involved are very serious, when the potential of the conductor is maintained at 60,000 volts or over. The loss due to the development of heat on account of the resistance of the conductor can theoretically be diminished as much as we please, by merely increasing the size of the conductor; but conductors sufficient in size to render the heat loss negligible are too expensive to be commercially practicable. Lord Kelvin, in an attempt to determine the most economical size of conductor for electrical transmission, came to the conclusion that the maximum economy is attained when the conductor is of such a size that «the annual interest on the capital outlay is equal to the annual cost of energy wasted.» Under ordinary conditions, this is found to lead to the conclusion that the most economical current-density in the conductor is about 380 amperes per square inch of sectional area of the conductor. For the case in which a given horse power is to be delivered at a given distance, the condition is somewhat different, and not so simple. Professors Ayrton and Perry, who have investigated this case, have given somewhat complicated formulæ for determining the most economical cross-section of the conductor. (Consult Kent, ‹Engineer's Pocket Book,› and the references there given). In long distance transmission it is customary to adopt, for the transmission line, a far higher potential than is desired for the operation of the machinery at the delivery end, since this artifice makes it possible to transmit a given quantity of electrical energy over a given conductor with a smaller heat loss than would be involved if the transmission were effected at a lower potential. When the transmitting current is alternating, the reduction of potential at the delivery end may be effected by means of a transformer; but when the transmitting current is direct, it is customary to employ a «motor-generator,» which consists of a motor, actuated by the transmission current, coupled on the same shaft with a dynamo, which gives out a current adapted to the work to be done. The motor-generator is also used to transform an alternating transmission current into a continuous current, when the continuous current is desired for delivery purposes. Some of the problems of electrical transmission have been solved on a very large scale at Niagara Falls, where the water power is partially utilized for mechanical purposes. A portion of the power that is developed in the turbine houses is transmitted electrically to Buffalo, for the operation of electric railways and for other purposes, and the remainder is utilized, also in the electrical form, in factories in the more immediate neighborhood of the falls. The modern electric transmission line for high voltages is of aluminum cable on a steel core — to give it strength and lessen the sag between towers — or of copper-clad steel, known to the trade as «Monnot metal.» The latter is an ingeniously devised steel core which is first alloyed with copper on its surface, and then covered with a heavy coating of pure copper. The aluminum cable has to be 61.6 per cent larger in volume than a copper cable to obtain an equally low resistance. As the weight of aluminum is 30.2 per cent that of an equal volume of copper, the weight of aluminum required for a stated conductivity is 48.8 per cent of the weight of copper having the same conductivity. An aluminum line is, therefore, much cheaper than a copper line. For voltages up to 66,000 the «petticoat» type of insulators, set upon iron pins, are commonly used. The «petticoats» or porcelain «bells» are nested one within another until the insulation is sufficient to prevent the current from the cable from leaping to the supporting pin. The protective power ranges about 15,000 volts to each bell; that is, for a current of 44,000 volts, three bells nested are required; for 66,000 volts, at least four bells in the nest. The great weight of these porcelain masses limits their use to the smaller voltages, so that above 66,000 volts the suspension type of insulation is used. This consists of a series of porcelain discs hanging in horizontal positions one below another and suspended through their centres. As many discs may be added to the «string» as are needed to insulate the particular current. On 110,000-volt lines five or six discs are used. On 140,000 volt lines the number of dics is increased to 10 and the space between the horizontal cables is not less than 12 feet. On lines of low voltage wooden poles of white cedar (arbor vitæ) or chestnut are generally used. They have a «life» of from 10 to 12 years. Concrete poles are practically indestructible, but very expensive to set, on account of their great weight. For high voltage transmission lines the steel tower of lattice construction is favored. These are set from 400 to 1,000 feet apart. The longest known span is one reaching across the Saint Lawrence River at Three Rivers (Canada) which is a clear span of 4,800 feet from towers 315 feet high; the cable carrying 140,000 volts. Underground conduits are common for electric transmission in cities. They are variously constructed: of artificial stone — made by mixing limestone and Portland cement; or of fibre pipe — made of woodpulp saturated with a bituminous compound. The cables used in underground transmission are usually three-phase, three-conductor cables of the so-called «clover-leaf» pattern, the conductors being insulated by manila-rope paper of the finest quality saturated with resin and resin oil. This type of insulation is as durable as the lead sheath in which the cable is encased; which is all that can be desired. The voltage which such an underground cable can carry without loss, or perforation of the insulation, ranges up to a maximum of 300,000 volts.

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POWERS, Hiram, American sculptor: b. Woodstock, Vt., 29 July 1805; d. Florence, Italy, 27 June 1873. He received his education at the district school, and on the removal of the family to Ohio in 1819 was employed as assistant to a clock-maker. At the same time he learned the art of modeling in clay from a German sculptor. He was subsequently appointed director of the waxwork department of the Western Museum of Cincinnati, an employment he pursued for seven years. In 1835 he went to Washington, and was for some time employed in modeling busts of distinguished men. With the proceeds derived from these efforts, and the aid of Gen. John Preston, he was enabled to visit Italy. In 1837 he established himself at Florence, where he resided until his death. His statue of 'Eve Tempted,' which excited the approval of Thorwaldsen, was produced in 1838; in 1843 was modeled the still more popular 'Greek Slave,' of which six copies in marble and innumerable casts and reduced copies are in existence. Among his other statues the most notable are 'The Fisher Boy' (1846); another 'Eve Tempted' (1850); 'America' (1854), destroyed by fire in 1866; 'Il Penseroso' (1856); 'California' (1858); and 'The Indian Girl' (1872); and statues of Washington for the State of Louisiana, of John C. Calhoun for South Carolina, of Daniel Webster for Boston, and of Franklin and Jefferson. He also executed several ideal busts, such as 'Ginevra' (1840–65); 'Proserpine' (1845); 'Psyche' (1849); 'Diana' (1852); 'Christ' (1866); 'Faith' (1867); 'Clytie' (1868); 'Hope' (1869); and 'Charity' (1871); besides busts of Jackson, John Quincy Adams, Edward Everett, Van Buren, Longfellow, John Marshall, Philip Sheridan and others.

POWERS, Le Grand, American statistician: b. Preston, N. Y., 1847. He was graduated at Iowa State University in 1872 and was engaged in active ministerial work 1874–90. He was commissioner of labor in Minnesota 1891–99, and has since been chief statistician of the United States census, in charge of agriculture. He has published 'Minnesota Bureau of Labor Biennial Reports' (1890–99); 'Farmer Hayseed' (a reply to 'Coin's Financial School') (1895) Twelfth Census of the United States (Vols. V–VI); Census Report on wealth, debt, taxation and other statistics of cities. He is also a frequent contributor to newspapers, American and English reviews and financial and statistical juornals.

POWERS OF CORPORATIONS. See Corporations, Legal.

POWHATAN, pow-hạ-tăn', Indian sachem: b. about 1550; d. 1618. This was the name of his tribe; his own was Wahunsonacook. Originally he was at the head of eight tribes, but being a man of great natural abilities he raised himself from the rank of a chieftain to the command of 30 tribes, numbering about 8,000. (See Powhatan Indians). His dominions included the country between the James and Patuxent, and extended into the interior as far as the falls of the chief rivers. One of his abodes was a village of a few wigwams near the present site of Richmond. A large guard of warriors usually attended him, and his dwelling was watched at night by sentinels. After the extension of his power northward, he dwelt mainly at Werowocomoco, on York River, in the present county of Gloucester, a few miles from Jamestown. He was disposed to look with dislike upon the coming of the whites. Capt. John Smith, in 1607, was held for some time by Powhatan as a prisoner, and according to the tradition, when Smith had been condemned to death, the sachem yielded to the entreaties of his daughter Pocahontas (q.v.) and spared his life. Two years later Powhatan was crowned «Emperor of the Indies» by Smith and Capt. Christopher Newport, during a visit which they paid him in quest of supplies. Smith afterward made an unsuccessful attempt to capture Powhatan in order to obtain a supply of corn, and in revenge for this Powhatan prepared to exterminate the English, but was foiled by the watchfulness of Pocahontas. The quarrels between Powhatan and the English did not cease until the marriage of his daughter to John Rolfe (q.v.), after which he was their firm friend. Smith's description of Powhatan represents him as a «tall, well-proportioned man, with a sour look, his head somewhat gray, his beard so thin that it seemed none at all, his age near sixty, of a very able and hardy body to endure any labor.» Powhatan died in 1618 and was succeeded by his brother Opitchapam, who was soon supplanted by a younger brother, Opechancano (q.v.) already a very noted warrior.

POWHATAN, Indian «pawatan» «falls in a current of water,» a confederacy of southern Algonquian tribes resident at one time within the territory now occupied by the State of Virginia and a part of Maryland. They were surrounded by the Monacan, Manahoac, Chowanoc, Nottoway and Meherrin. When the Powhatan first came into contact with the whites they were one of the most numerous and powerful tribes in America east of the Mississippi. On his map of their territory Capt. John Smith gives 160 of their villages, which were only a part of the territory under the control of their high chief. The Powhatan were among the first tribes on the continent and north of Mexico visited by the early explorers. As early as 1570 the Jesuits established a mission among them; and a few years later reports of them reached the English who finally came into contact with them on the foundation of the Jamestown settlement in 1607. The Indians were alternately friendly and hostile until finally a unity of interest was created between the whites and the natives through the marriage of Pocahontas (q.v.), the daughter of the high chief, to John Rolfe, an Englishman of middle-class family. On the death of Powhatan, father of Pocahontas, in 1618, he was succeeded by his brother Opechancano who had always been an enemy of the white settlers. On 22 March 1622 he attacked, at the same time, all the settlements in Virginia, killing 347 English and destroying all the settlements except Jamestown. The settlers declared war to the death against the Powhatan and made arrangements to render them helpless by sending against them three yearly expeditions with a view to molesting them in every way and especially of destroying their plantations. For 14 years the war continued during which both sides suffered severely. In 1625 General Wyatt defeated a force of 1,000 Powhatan at the battle of Paumunkey and destroyed their villages and crops. The Indians continued the struggle fiercely, but at a great disadvantage owing to the better arrangement of the whites. A peace made in 1636 lasted seven years, when the aged Opechancanough headed another massacre in which over 500 whites were killed in one day. The settlers retaliated and finally captured and shot Opechancanough and broke up the confederacy (1642), after which each tribe made its peace as best it could with the whites. Again the Indians rose in revolt, but their stronghold, near Richmond, was stormed and men, women and children were put to the sword (1676). Some 46 years later a treaty was signed in Albany between the whites, the Powhatan and the Iroquois in which they mutually agreed to keep the peace. From this time on they gave no further trouble. They gradually mixed with the negroes and whites, and from time to time individuals, or even whole decimated tribes, joined other tribes not of their own tongue until finally they disappeared as a tribal organization. The Powhatan are supposed to have numbered at one time at least 8,000. They lived in community houses which were well built and varying in length from about 35 to over 100 feet. Most of their villages were fortified with post-palisades about twice the height of a man. There were from one to three of these walls, one within the other. They had gone a considerable way along the road to the sedentary life that leads to civilization. They had extensive plantations of corn, beans, pumpkins, melons, squashes, vegetables, tobacco and fruits; and they kept account of time and their business transactions on knotted strings much as the ancient Peruvians did. They are represented by a considerable number of Mestizos, most of whom are either farmers or fishermen; and they are as expert to-day as in olden times in the making and management of canoes and fishing nets. See POCAHONTAS; OPECHANCANO; VIRGINIA. Consult Eggleston, E., 'Pocahontas' (New York 1879); Hamor, R. A., 'True Discourse of the Present Estate of Virginia' (London 1915); Hodge, W. H., 'Handbook of the American Indians' (Washington 1910); Price, W. T., 'Historical Sketches of Pocahontas County, West Virginia' (Marlinton 1901); Waston, V. C., 'The Princess Pocahontas' (Philadelphia 1916).

POWNALL, Thomas, English statesman, colonial governor and author: b. near Lincoln, 1722; d. Bath, 25 Feb. 1805. He was graduated at Cambridge in 1743. In 1753 he went to America as private secretary to Sir Danvers Osborn, governor of New York, and in 1757 was made governor of the colony of Massachusetts Bay. He showed considerable disinclination to carry out the policies of his superiors in London and as a result he was transferred to South Carolina in 1760 as governor of this colony. Without having gone to South Carolina he returned to England in June 1760 and soon after his arrival resigned the governorship. In 1762–63 he was comptroller-general of the expenditures of the army in Germany, and in 1768 was elected to Parliament. He earnestly opposed the measures of the government against the colonies. After being three times returned to Parliament, he retired in 1780 and passed the remainder of his life in antiquarian studies. In the sphere of scholarship he achieved a greater reputation than that which he won in the field of politics. His writings have a wide range of subjects, and among his principal works are ‘Administration of the Colonies’ (1764); ‘A Memorial to the Sovereigns of America’ (1773); ‘A Topographical Description of the Middle Colonies’ (1776); ‘A Memorial to the Sovereigns of Europe on the State of Affairs between the Old and the New World’ (1780); ‘Notices and Descriptions of the Antiquities of the Provincia Romana of Gaul’ (1788); ‘Intellectual Physics’ (1795); ‘A Treatise on Old Age’ (1801); ‘A Memorial to the Sovereigns of Europe and the Atlantic’ (1803), and numerous monographs on antiquarian subjects. Consult Pownall, Chas. A. W., ‘Thomas Pownall’ (London 1908).

POYNINGS, poin'ĭngz, Sir **Edward**, English statesman: b. 1459; d. 1521. As a result of his activity in the Kentish revolt against Richard III in 1483 he had to flee to the Continent. In 1485, however, he returned to England in the train of the Earl of Richmond, afterward Henry VII. During the life of this monarch he was one of the most favored and trusted members of his entourage, a position which he also occupied under his successor, Henry VIII. In 1493 he was made governor of Calais. He went as lord deputy to Ireland in 1494 and there defeated Perkin Warbeck at Waterford. During his administration of Ireland he summoned a Parliament at Drogheda, which, at his instigation, gave to the English Crown and the king's Privy Council direct control of Irish administrative affairs. The act by which this was accomplished became known as the Poynings' Law (q.v.; also see Ireland, History). After his recall in 1496 he was made warden of the Cinque Ports. Henry VIII, immediately upon his succession to the throne after the death of Henry VII in 1509, made him a member of the King's Council. During the following years he was frequently entrusted with important diplomatic missions and military commands, and in 1520 he was especially active in arranging and preparing for the Field of the Cloth of Gold (q.v.), the famous meeting between Henry VIII and Francis I of France.

POYNINGS' LAW, or **STATUTE OF DROGHEDA**, an act of the Irish Parliament, passed in 1495, whereby it was provided that no Irish Parliament should be summoned and no act passed without the previous approval of the English king and his Privy Council under the great seal of England. At the same time all laws that had so far been enacted and were in force then in England were declared of force in Ireland. It was so named from Sir Edward Poynings (q.v.). It was repealed in 1782. Consult ‘The Policy of Poynings' Law’ (Dublin 1770).

POYNTER, point'tĕr, Sir **Edward John**, English painter: b. Paris, 20 March 1836; d. London, 26 July 1919. He received his early education in Westminster School and in Ipswich, and was the pupil of Gleyre in Paris from 1856 to 1859. In 1860 he returned to London and was elected Royal Academician in 1876. From 1894 to 1905 he was director of the National Gallery. On the death of Sir John Millais in 1896 he was elected president of the Royal Academy and the same year was knighted. He was created a baronet in 1902. His paintings in oil and water colors are distinguished by originality of conception, faultless drawing and strong color qualities, and the most remarkable of them are ‘Israel in Egypt’ (1867); ‘The Catapult,’ an incident in the siege of Carthage (1868); ‘Faithful unto Death’; ‘Proserpine’; ‘Perseus and Andromeda’ (1872); ‘The Fortune Teller’ (1877); ‘Rhodope’; ‘The Golden Age’; ‘Zenobia in Captivity’ (1878); ‘The Meeting of Solomon and the Queen of Sheba’ (1891); ‘Horæ Serenæ’; ‘Idle Fears’ (1894); ‘The Ionian Dance’ (1899); ‘The Cave of the Storm Nymphs’ (1903); ‘The Nymphs' Bathing Place’ (1904); ‘The Cup of Tantalus’ (1905); ‘Lesbia and Her Sparrow’ (1907); ‘Brewing a Storm’ (1909); ‘A Naval Disaster’ (1912); ‘At Low Tide’ (1913); ‘The Sea Bath’ (1914); and portraits of King Edward VII and of numerous persons of prominence as well as many water colors, figures and landscapes. Also two sets of designs for the new coinage of 1894 and cartoons for mosaics of Saint George and Saint David in Westminster Palace. During the years 1872–73 he was engaged in frescoing the walls of Saint Stephen's Church, Dulwich. He also furnished designs for the decoration of the interior of the dome of Saint Paul's Cathedral with subjects from the Apocalypse, as well as for the mosaics in Westminster Palace. He also published ‘Ten Lectures on Art’ (1879); ‘Classic and Italian Painting’ (with P. R. Head, 1880); ‘German, Flemish and Dutch Painting’ (with H. J. Wilmot Buxton, 1881). He acted as editor of ‘The National Gallery’ (1899), containing reproductions of all pictures in the National Gallery acquired up to the end of 1899. Du Maurier in ‘Trilby’ draws a delightful sketch of Poynter in their old student Paris days and of his passionate study and admiration for all the great masters.

POYNTING, poin'tĭng, **John Henry**, English scientist: b. Monton, Lancashire, 9 Sept. 1852; d. Birmingham, 30 March 1914. He was educated at Owens College, Manchester, and Trinity College, Oxford, was assistant to Prof. Balfour Stewart in the physical laboratory at Owens in 1876–79, and in 1880 was appointed to the chair of physics at Mason College (now Birmingham University). In 1905 the royal medal of the Royal Society was conferred upon him. He has contributed papers on electrical theory, gravitation, radiation and the mean density of the earth to the ‘Philosophical Transactions’ and the ‘Proceedings’ of the Royal Society; published his Adams prize essay on ‘The Mean Density of the Earth’ (1891); and ‘A Text-book of Physics’ (with Sir J. J. Thomson, 1902–14).

POZZO DI BORGO, pŏt'sō dē bōr'gō, **Carlo Andrea**, Count, Russian diplomat: b. Alata, Corsica, 8 March 1764; d. Paris, 15 Feb. 1842. He was educated at Pisa and became an advocate. In 1791 he was elected to the National Assembly. In his youth he was friendly with Napoleon Bonaparte and his family, but later joined Paoli in his opposition to Napoleon and became the bitter enemy of the latter. As a result he had to flee from France. In 1794, when the English instituted a protectorate over Corsica, he became president of the council, holding this position until the withdrawal of the English forces in 1796. At that time he was specifically excluded by Napoleon from the amnesty which he extended to his other Corsican opponents and he, therefore, went for his safety to England where he resided for a number of years, working to the fullest extent of his power against Napoleon. In 1804 he entered the Russian diplomatic service and was employed in various missions of importance, continuing at all times his activities against Napoleon. As a result of this attitude he resigned from the Russian diplomatic service in 1807 after Emperor Alexander I had concluded a treaty with Napoleon. Again he retired to England where he resided until 1812 when he was recalled by Emperor Alexander. He now devoted himself more than ever to the prosecution of the war against Napoleon. He succeeded in persuading Bernadotte and Sweden to turn against Napoleon and was most active in forming the coalition against the French emperor. He played an important part at the Congress of Vienna. Throughout his whole diplomatic career he openly and constantly displayed his friendship for France, which country honored him in 1818 by making him a count and peer of France. From 1830–35 he was Russian Ambassador at Paris and from 1835–39 at London. Consult Uvarov, S. S., ‘Stein et Pozzo’ (1846); Maggiolo, A., ‘Corse, France et Russie, Pozzo di Borgo’ (Paris 1890); ‘Correspondance Diplomatique du Comte Pozzo di Borgo et du Comte de Nesselrode’ (Paris 1890–97).

POZZUOLI, pŏt-soo-ō'lē, Italy, a city on the bay of the same name, six miles west of Naples, at the western foot of the Solfatara and in a volcanic country known to the Romans as the Phlegræan Fields. Near by is the Avernian Lake famed as the entrance to hell both in Virgil's sixth Æneid and in early Christian legend, which pointed out here the place where Christ descended into hell. Remains of Cicero's villa are near the town, which is particularly famed for its amphitheatre, where 30,000 spectators could sit and in which there were naval battles as well as the ordinary gladiatorial contests. The so-called Serapeum is an archæological puzzle and may have been a town-hall; traces of the action of sea water on several pillars not now touched by high water seem to prove that the coast, possibly from volcanic disturbances, has undergone marked and recurrent changes. The only other ruin of importance is that of the temple of Augustus, the site of which is occupied by the cathedral, which preserves six of the original Corinthian columns. Pozzuoli is a good fishing-port; exports the volcanic sands called pozzolana, which are used in making cement; has important mineral baths in the vicinity, and is the site of an ordnance factory, a branch house of Armstrong and Company, which makes armor plate and cannon for the Italian government.

Pozzuoli was founded by Greek exiles from Samos in the 6th century B.C., as Dicæarchia, but the Italians called it Puteoli, «the wells,» because of the sulphurous cavities in the earth, and the city continued to be known under this name after it was made a Roman colony in 194 B.C. The city became the greatest port of Italy and on entrepôt for Oriental commerce; goods were sent overland hence to Rome and the dangerous navigation of the coast of Latium avoided. Even after Ostium was built the port retained its importance, and its beautiful coast and curative springs and baths made it a famous resort. During the Middle Ages it suffered a great deal from frequent convulsions caused by nearby volcanos. Pop. (1910 census) 28,167. Consult Loffredi, F., ‘Antiquas Peteolorum’ (in ‘Thes. Antiq. et Hist. Ital.,’ Vol. IX, part 4, 1723); Paoli, P. A., ‘Avanzi delle Antichita che Esistano a Pozzuoli, Cuma e Baja’ (Florence 1768); Stefani, Carlo de, ‘La Villa Puteolana di Cicerone’ (in ‘R. Accad. d. Lincei. Rendic. ‘Classe d. Sci. Fis.,’ Ser. V. Vol. X, part 1, p. 128, Rome 1901); Huelsen, Christian, ‘Inschrift von Pozzuoli’ (in Kaiserliches Deutsches Archæologisches Institut Mitteilungen, Roemische Abteilung, Vol. XXIII, p. 71, Rome 1908).

PRADIER, prā-dē-ā, **James**, French sculptor: b. Geneva, 23 May 1792; d. near Paris, 14 June 1852. In his youth he was apprenticed to a jeweler in his native city where he engraved rings and watch cases. At this work he showed so much ability that he was placed in the Geneva School of Design. In 1809 he went to Paris where he studied design under Meynier, and sculpture in the studio of Lemot. In 1813 he gained the prize of the Academy for a bas-relief of Philoctetes and Ulysses, and this work procured his admission to the French Academy at Rome. Here he studied the antique and returned to Paris with two statues, one of Bacchante and the other of a son of Niobe, now in the Luxembourg. In 1821 he went again to Rome, where he remained till 1823 and brought back a statue of Psyche, which he had made out of part of the shaft of an ancient marble pillar found at Veii. This work, too, is now in the Luxembourg. From this period he worked constantly at Paris and produced a great number of larger and minor sculptures, including a Venus, a group of the Three Graces (now at Versailles), a plaster statue of Jean Jacques Rousseau, after which the casting at Geneva has been made, and Cyparissus with his goat and a huntress. Admitted to the Institute in 1827, he afterward executed, among other works, a Prometheus, a Faun and Bacchante, a Phidias (now in the Tuileries Gardens), the bas-reliefs on the pediment of the Chamber of Deputies, the allegorical figures of Lille and Strassburg in the Place de la Concorde at Paris, the Industry in front of the exchange, the Flora, which he considered one of his most successful works, the 12 colossal Victories on the monument of Napoleon in the Hotel des Invalides, the Atalanta in the exhibition of 1851 and the Sappho exhibited in 1852. The colossal fountain at Nimes is another example of his work, as is also the monument of the Duc de Berry in the church of Saint Louis at Versailles. The execution of his works ranks him a sculptor of the first order, but he is deficient in originality of conception, his monotone borders on insipidity and he sometimes strives to give life to his creations by a touch of meretriciousness.

PRADILLA, **Francisco**, frān-thēs'kō prā-dēl-yā, Spanish painter: b. Villanueva de Gallego, in the province of Saragossa, 24 July 1848. His parents were very poor, and the young Pradilla, who early in his youth showed a remarkable gift for drawing, had to undergo a hard struggle before he could find the ways and means to devote himself to the development of this gift. In 1863 he came to Madrid where he devoted himself zealously to the study of the old masters and became a pupil of Serri. Before long he was sent to the Spanish Academy of Fine Arts at Rome, of which he was one of the first pupils. His first signal achievement was ‘The Rape of the Sabines’; this was followed in 1878 by ‘Joanna the Mad, following the Coffin of Philip the Fair, her Husband.’ The latter was exhibited at the World's Exposition at Paris in the same year, where it created quite a sensation and was awarded a medal. It is now in the Prado at Madrid. His next important work was ‘The Surrender of Granada to Ferdinand and Isabella,’ a picture remarkable for spirited delineation of character, lifelike action and grandeur of style. It was awarded a first medal at the exposition in Munich (1883) and may now be seen in the Senate Hall in Madrid. Still another picture of the same type is the ‘Last Sigh of the Moor.’ In addition to these large canvasses he has produced many small genre pictures. Most of these illustrate modern life, especially amongst the peasants, and show keen observation, subtle power of individualization and a remarkable genius for realism. These small canvasses are masterpieces of their kind and have won for him an international reputation. The best known amongst them are ‘High Mass in the Pilgrims' Chapel at Guia’ (1891); ‘Market Day at Vigo’ (1892), and ‘Pilgrimage to the Shrine of Our Lady of Good Counsel’ (1895). He has also painted some mural decorations of great beauty in the Murgo Palace in Madrid. In 1892 he was made a member of the Berlin Academy and in 1896 he became director of the Royal Museum in Madrid.

PRADO, prä'thō, **Mariano Ignacio,** Peruvian politician: b. Huanaco, 1826; d. Paris, 1902. He engaged actively in a revolution which in 1854 overthrew General Echenique and led the opposition to President Pezet in 1865 which resulted in Pezet's resignation and his own designation as supreme chief. He then formed an offensive and defensive alliance with Chile, and declared war against Spain. A Spanish attack upon Callao was repulsed 2 May 1866, but his own position having been declared unconstitutional, he was obliged to leave Peru in January 1868 and went to Chile. Returning several years later he was elected President in 1876 and in 1879 declared war against Chile. Prado went to Europe in the same year, for the purpose, as was then stated, of obtaining a loan and ironclads, and in his absence the Presidency was seized by Pierola. He returned to Lima in 1886, but ceased to be active in politics. Consult Markham, C. R., ‘A History of Peru’ (Chicago 1892).

PRAED, prād, **Mrs. Campbell Mackworth.** See Praed, Rosa Caroline Murray-Prior.

PRAED, Rosa Caroline Murray-Prior, Australian novelist: b. Bromelton, Queensland, 27 March 1852. In 1872 she was married to Campbell Mackworth Praed (d. 1901) and in 1876 went to London where her Australian stories soon made her well known. She has been a prolific writer of popular fiction and many of her books have reached large editions. Amongst the most important of them are ‘An Australian Heroine’ (1880); ‘Policy and Passion’ (1881); ‘Nádine’ (1882); ‘Moloch’ (1883); ‘Zero’ (1884); ‘The Head Station’; ‘Affinities’; ‘The Brother of the Shadow’ (1885); ‘The Bond of Wedlock’; ‘Miss Jacobsen's Chance’ (1887); ‘The Romance of a Station’ (1889); ‘The Romance of a Chalet’; ‘The Soul of Countess Adrian’ (1891); ‘December Roses’ (1892); ‘Outlaw and Law Maker’ (1893); ‘Christina Chard’ (1894); ‘Mrs. Tregaskiss’ (1896); ‘The Scourge Stick’ (1898); ‘Madame Izan’ (1899); ‘As a Watch in the Night’ (1900); ‘The Insane Root’; ‘Dwellers by the River’ (1902); ‘Fugitive Anne’ (1903); ‘Nyria’ (1904); ‘A Maid of the River’ (1905); ‘The Lost Earl of Ellan’ (1906); ‘The Luck of the Leura’ (1907); ‘By Their Fruits’ (1908); ‘Opal Fire’; ‘The Romance of Mademoiselle Aissé’ (1910): ‘Body of His Desire’ (1912); ‘Lady Bridget of the Never-Never Land’ (1915). She also published ‘My Australian Girlhood’ (1902), an autobiography; with Justin McCarthy (q.v.), ‘The Right Honorable’ (1886); and with Justin McCarthy and M. Menpes, ‘The Gray River’ (1889). Consult McCarthy, Justin, ‘Our Book of Memories; Letters of Justin McCarthy to Mrs. Campbell Praed’ (London 1912).

PRAED, Winthrop Mackworth, English poet: b. London, 26 July 1802; d. there, 15 July 1839. He was educated at Eaton and Trinity College, Cambridge, was elected to a Trinity fellowship in 1827, and in 1829 was admitted to the bar. In Parliament he sat for Saint Germains in 1830–32, for Great Yarmouth in 1834–37 and for Aylesbury from 1837. Praed made some successful speeches in the House and was requested by Wellington to write for the *Morning Post* a defense against certain attacks on the Duke in the *Times*. He showed a remarkable gift for versification comparatively early in life, writing considerable poetry of the lighter sort even during his public school and college days. His political writing was too restrained wholly to reach its mark; but his verse is marked by a lightness of touch and a metrical ease and finish which in more recent times finds its closest resemblance in the work of Austin Dobson. He excelled in *vers de société*, though he displayed, as in the ‘Red Fisherman,’ an imaginative force which suggests broader fields. Of his writings the following have been published in book form: ‘Charades’ (New York 1852); ‘Essays’ (London and New York 1887); ‘Poems’ (London 1865). Consult ‘Kraupa, Matilde, ‘Winthrop Mackworth Praed’ (in ‘Wiener Beitraege Zur Englischen Philologie,’ Wien and Leipzig 1910).

PRÆFECT, the title of various civil and military officials of ancient Rome. Of these the most important was the *præfectus urbis*, or warden of the city, originally called *custos urbis*. The name *præfectus urbi* does not seem to have been used till after the time of the decemvirs. During the kingly period and the early years of the republic the *custos urbis* exercised within the city all the powers of the chief of the state in his absence; he convoked the senate, held the comitia, and on any emergency might take such measures as he thought proper. When the office of *prætor urbanis* (see Prætor) was instituted the wardenship of the city was merged in it; but the conservative spirit of the Romans still induced them to appoint annually a *præfectus urbi* for the time during which the consuls were absent from the city to celebrate the Feriæ Latinæ, a festival held on the Alban Mount. Under Augustus, however, the office ceased to be a sinecure. The *præfectus urbi* was a permanent magistrate whom the emperor invested with all the powers necessary to maintain peace and order in the city. He had under him a sort of police called *milites stationarii;* and the powers of the office were gradually so far extended that at last there was no appeal from his sentence except to the emperor. The *præfectus prætorio* was the officer who commanded the troops who guarded the emperor's person. (See Prætorian Guards). The office was first instituted by Augustus, and was at first only military and had comparatively little influence attached to it; but under Tiberius it became second only to that of the emperors. From the time of Severus to that of Diocletian the præfects had the superintendence of all the departments of the state — the palace, the army, the finances and the law; they also had a court in which they decided cases. In addition to these functionaries there were the *præfectus aquarum,* charged with the regulation of the water supply of the city; the *præfectus ærarii,* who had charge of the public treasury; the *præfectus vigilum,* who commanded the night-watch; with others of less importance.

PRÆMUNIRE, prē-mū-nī'rē, the opening words of the writ issued preparatory to the prosecution of certain offenses supposed to imply legal contempt toward the sovereign or the government — *præmonere* or *præmunire facias* A. B. (Cause A. B. to be forewarned that he appear before us, etc.). Gradually the word acquired a wider meaning, being used to denote both the offense and the penalties incurred. The first statute of præmunire was passed during the reign of Edward I in 1306 and was intended to repress the papal encroachments on the rights of the Crown, and several subsequent statutes before the Reformation greatly extended the number of penal acts under this title. By still later statutes acts of a very miscellaneous nature were rendered liable to the penalties of præmunire, as knowingly and wilfully solemnizing, assisting or being present at any marriage forbidden by the Royal Marriage Act; asserting by preaching, teaching or advisedly speaking that any person other than according to the acts of settlement and union has any right to the throne, or that the sovereign and Parliament cannot make laws to limit the descent of the Crown; to assert that both or either of the Houses of Parliament have or has a legislative authority without the sovereign; and so on. Cathedral chapters in England which refused to elect the bishop nominated by the Crown were liable to be prosecuted on præmunire. The punishment was forfeiture and imprisonment during the sovereign's pleasure. Prosecution by writ of præmunire has been obsolete, however, for a long time. Consult 'Statutes of the Realm'; Reeves, John, 'History of the English Law' (London 1869); Stubbs, William, 'Constitutional History of England' (Oxford 1875–78); Holdsworth, W. S., 'A History of English Law' (London 1903–09); Jenks, Edward, 'A Short History of English Law' (Boston 1912).

PRÆNESTE, prē-nĕs'tē. See Palestrina.

PRÆTOR, originally the official title of the consuls at Rome. When the patricians were compelled to acquiesce in the consulship being thrown open to the plebeians, they stipulated that a new curule magistrate should be appointed from the patricians exclusively, to act as supreme judge in the civil courts. On this magistrate the title of prætor was bestowed. In 337 B.C. the prætorship was thrown open to the plebeians. About 240 B.C., the number of aliens residing in Rome had increased to such an extent that it was found necessary to appoint a second prætor, who should decide suits between aliens or between aliens and citizens. He was known as the *prætor peregrinus,* the other prætor, *prætor urbanus,* having cognizance of suits between citizens only. In 227 B.C., the number was increased to four, the two additional prætors to act as governors of provinces. By Sulla the number was augmented to eight, by Julius Cæsar to 10, 12 and eventually to 16. The prætors held their offices for one year and were afterward sent out by lot as governors of provinces.

PRÆTORIAN GUARDS, a body of permanent troops, established by Augustus as Imperial Life Guards, in imitation of the *cohors prætoria,* or bodyguard attached to the person of the commander-in-chief of a Roman army. The Prætorian guards were kept up by successive emperors and, being under special organization and enjoying several privileges, they became in time so powerful that they were able to raise and depose emperors at their will. They were reorganized by Septimius Severus and were finally suppressed by Constantine the Great.

PRÆTORIUM, (1) the official residence of a prætor or governor of a Roman province: hence, a hall of justice; a judgment-hall; a palace. (2) That part of a Roman camp in which the general's quarters were.

PRAGA, prä'gä, Russian Poland. See Warsaw.

PRAGMATIC SANCTION (*Sanctio Pragmatica*), a public edict relating to important state business, pronounced by the head of a state and differing from the simple rescript, in that the latter was a declaration of law in answer to a question propounded on behalf of an individual. The pragmatic decree was considered irreversible and formed part of the fundamental law of the country. In European history the following are the most important pragmatic sanctions: (1) The ordinance of Charles VII of France, drawn up at Bourges in 1438, conformably to the decrees of the Council of Basel and on which rest the claims of the Gallican liberties. It was repealed by Francis I. (2) The instrument published in 1713 by which the German emperor, Charles VI, being without male issue endeavored to secure the succession to his female descendants. It was in accordance with this instrument that he settled his dominions on his daughter Maria Theresa. He induced most of the European sovereigns to guarantee it; but Charles Albert, elector of Bavaria, the next heir to his dominions, refused; this caused the Austrian War of Succession after the death of the emperor in 1740. In the Peace of Füssen (1745) Bavaria acknowledged the pragmatic sanction. (3) Charles III of Spain, when he ceded the throne of Naples to his third son and his successors in 1759, called the law of succession which he prepared for this branch of his family *sanctio pragmatica*. Consult Wolf, A., ‘Die Geschichte der Pragmatischen Sanktion bis 1740’ (Wien 1850); Turba, De Gustav, ‘Die Grundlagen der Pragmatischen Sanktion’ (in ‘Wiener Staatswissen-Schaftliche Studten,’ Vol. X, part 2, and Vol. XI, part 1, Leipzig and Wien 1911–12).

PRAGMATISM. The term pragmatism, as employed in philosophy at the present time, denotes the general tendency to subordinate logical thinking to the ends of practical life and to find the test of the truth of ideas in their practical consequences. There are thus two somewhat distinct sides to the doctrine, which we find differently emphasized by different writers. On the one hand, this view points out that thought owes its origin to the needs and demands of the practical life. Thought is thus a tool or instrument that is always invoked to meet a particular crisis or problem resulting from a concrete situation. Thought, therefore, does not aim at truth in general. Its business is to discover, in concrete circumstances, the best means to the realization of some practical end that life demands.

This side of the doctrine has been chiefly elaborated by Prof. John Dewey and those associated with him at the University of Chicago as colleagues or students. These writers have connected their theory with the doctrine of evolution and support it mainly by arguments and analogies drawn from this source. On the other hand, to decide regarding the truth or falsity of any theory or conception, we must also appeal to the practical consequences that result from it. A theory is demonstrated in the only possible way when it is shown that it will “work”; that is, that the results that we wish to obtain in a given situation follow from it. It is only in the light of these results that a conception has meaning. Apart from its practical consequences, a conception is an abstraction without meaning or significance and consequently without truth or falsehood.

This practical test of the truth of a theory through an appeal to its consequences is the element in pragmatism that has been mainly emphasized by C. S. Peirce and Prof. William James. Peirce first employed the term and outlined the doctrine in an article in *The Popular Science Monthly* (January 1878), though he put it forward merely as a practical method of avoiding abstractions by making clear to oneself the consequences in terms of action of general logical conceptions. The present currency of the position in America and England is, however, largely due to Professor James, who has elaborated and enforced it in his psychology and in a number of popular works and articles. The names of Peirce and James are so closely connected with pragmatism that we quote here the formal definitions of the term which they have written for Baldwin's ‘Dictionary of Philosophy.’ Peirce describes the doctrine as follows: “The opinion that metaphysics is to be largely cleared up by the application of the following maxim for attaining clearness of apprehension: ‘Consider what effects, that might conceivably have practical bearings, we conceive the object of our conception to have. Then our conception of these effects is the whole of our conception of the object.’ ” James defines pragmatism: “The doctrine that the whole ‘meaning’ of a conception expresses itself in practical consequences, consequences either in the shape of conduct to be recommended, or in that of experience to be expected, if the conception be true; which consequences would be different if it were untrue, and must be different from the consequences by which the meaning of other conceptions is expressed. If a second conception should not appear to have other consequences, then it must really be only the first conception under a different name. In methodology it is certain that to trace and compare their respective consequences is an admirable way of establishing the differing meanings of different conceptions.”

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PRAGUE, präg (German Prag; Bohemian Praha), Austria-Hungary, the capital of Bohemia and the third largest city of the empire, 217 miles by rail northwest of Vienna and 118 miles southeast of Dresden. Its site is a regular basin, traversed by the river Moldau, from the banks of which the city's buildings rise in terraces, till they are terminated and enclosed by hills of considerable height. Of nine bridges including two railway viaducts the most striking is the Karlsbrücke, dating from 1357–1503, and reconstructed after damage by a flood in 1892; it is 543 yards long with tower gateways at each end and buttresses adorned with statues of Saint John Nepomuk, the patron saint of Bohemia, and other saints. The mediæval fortifications and ramparts have been gradually demolished since 1866 and their sites occupied by pleasure grounds, boulevards, dwellings, etc. The city is divided into eight districts, the Altstadt, Josephstadt, Neustadt, Vysehrad and Lieben on the right, and the Kleinseite, Hradschin and Holeschowitz-Bubua on the left bank. Outside the line of the old walls lie the suburbs Karolinenthal, Smichow, Weinberge, Zizkov and others. The Altstadt and Josephstadt, the latter formerly the Jewish Ghetto, lie along the right bank toward the north. The streets of the Altstadt are narrow; it is the principal seat of trade and business and contains some of the best stores, besides numerous churches, ecclesiastical and educational establishments. The Neustadt encloses the Altstadt on the northeast, east and southeast. Though newer than the other, it is still very ancient, having been built by the Emperor Charles IV in 1348. On the opposite side the Kleinseite forms the aristocratic quarter, the chosen abode of the Bohemian nobles and the site of several remarkable palaces. The Hradschin, to the west of the Kleinseite, occupies the side of a steep hill, is of less extent and contains fewer houses than the other quarters, but the chief public edifices. Among these are the royal palace, formerly palace of the Bohemian kings, situated in the Hradschin, parts of which date back to the 14th century; the Gothic cathedral, begun in 1344 and still uncompleted, also in the Hradschin; the Clementinum, the seat of the theological and philosophical faculties of the university, erected by the Jesuits in 1653–1726; the Carolinum, the seat of the university since 1383 and still devoted to the faculties of law and medicine; the Teynkirche, a Gothic church, begun in 1370, historically interesting as the place where the Bohemian estates made George Podiebrad their king, and containing the grave of the celebrated Danish astronomer, Tycho Brahe, who spent his last years at Prague; the palace of Wallenstein, originally a structure of great magnificence, but now much dilapidated; the Alte Rathaus (old town hall), an irregular Gothic edifice, partly of the 15th century and partly of the early 19th century, with a fine old clock dating back to 1490; the chief synagogue of the Jews, rebuilt in 1338 after the burning of the Jewish quarter; the military hospital, a large and magnificent edifice, originally erected by the Jesuits as a college; German and Bohemian theatres, the opera house, the national museum, museum of natural history, picture gallery, the German and Bohemian technical colleges, Landesbank (1896), municipal savings bank (1894), central market hall (1896), the new Ritterakademie (1896), the Municipal Museum, the Museum of Industrial Art (1899), etc. Besides the cathedral there are a number of other smaller churches of considerable interest and antiquity, such as the Karlov church (1351–77), church of Saint Mary the Virgin (1348–72), church of Our Lady of the Snows (about 1347), Saint Thomas' Church (14th century), Saint George's Church (1142–50), etc. The university, founded in 1348, had 10,000 students at the beginning of the 15th century; but subsequently as a result of the Hussite disturbances it had a long period of inactivity. It received a new constitution in 1881, having now two co-ordinate sides or sections, one German and one Czech, with respectively 184 and 249 teachers, and 2,067 and 4,713 students (1914). It possesses a library of 370,000 volumes and 3,920 manuscripts, a fine observatory, museums of zoology and anatomy, a botanical garden, etc. The manufactures consist of gold and silver embroidery, silk, woolen, cotton and linen goods, buttons, hats, leather, paper, soap, refined sugar, vinegar, liqueurs, refined salt, gloves, sugar of lead, stearine and tallow candles, machines, musical and mathematical instruments, firearms, porcelain, jewelry, etc. The trade is of great importance; Prague, owing to its central position, and to its facilities of transport by river, roads and railway, being the great entrepôt for all the traffic of the kingdom. There are seven railroad stations and two river steamship lines. It has also several important fairs, particularly one for wool, which lasts seven days, and during which a great amount of business is done; that of Saint Wenceslas, the old patron saint of Bohemia; and that of Saint John Nepomuk, though these two are rather religious festivals than fairs, and are more crowded with devotees than dealers.

Prague is supposed to have been founded in 722 by the Duchess Libussa. In 1348 Charles IV founded the university, the first which Germany possessed, and it soon acquired such celebrity through the teachings of such zealous rectors as Huss and Jerome that it was resorted to from all quarters of Europe. In 1424 Prague was taken by the Hussites and almost destroyed, but after their submission to the emperor in 1433 the town was rebuilt. It reached its greatest prosperity and importance during the times of George Podiebead and his successors. It suffered severely in the Thirty Years' War, which, indeed, started in Prague, and in 1620 a battle was fought at the White Mountain in the neighborhood, in which the Elector-palatine Frederick V was defeated by the Emperor Ferdinand II and compelled to renounce his crown. In 1631 the city was captured by the Saxons, who were driven out a few months later by Wallenstein. In 1741 it was taken by the French and Bavarians, and three years later capitulated to Frederick the Great. After the Seven Years' War the city made rapid strides and enjoyed peace and prosperity until 1848, when the Austrian government caused it to be bombarded for two days, owing to the marked democratic demonstrations excited by the meetings of the Slavonic Congress within its walls. During the Austro-Prussian War in 1866 the city was occupied by the Prussians and here the treaty of peace was signed on the 23d of August.

Prague is the seat of the Imperial government and a Roman Catholic prince-archbishop. The city is governed according to a charter dating back to 1850. At the head of its government is a burgomaster. The citizens elect a board of aldermen of 90 members from whom a second body of 24 members, the Stadtrat, are chosen. The city owns three of its four gas works, several waterworks, the electrical powerworks and street railways and the slaughterhouse.

Besides the two universities and technical colleges there are numerous public, normal, high, manual training, trade and grammar schools, both for German and Bohemian children, as well as a number of private educational institutions. There are also nine public hospitals, a state insane asylum, orphan asylums and a large number of other charitable institutions. A number of newspapers are published daily in both German and Bohemian. Of the total population 90 per cent were Bohemians and 8 per cent Germans. Almost 90 per cent were members of the Roman Catholic Church and about 8 per cent Hebrews. Prague has shown the least increase in population of all Austrian cities during the decade 1900–1910, namely, less than one-half per cent. Pop. (1910 census) 223,741. Consult 'Privilegia Civitatum Pragentum' (Prague 1886); Tomek, W. W., 'History of the City of Prague' (in Bohemian, Vols. 1–12, Prague 1855–1901); 'Oesterreichisches Staedte-Buch' (Vienna 1899, to date); Neuwirth, J., 'Prag' (Leipzig 1901); Luetzow, F. H. H. von, 'Story of Prague' (New York 1902); Symons, Arthur, 'Cities' (London 1903).

PRAHRAN, prā-răn', Australia, a town in the state of Victoria, four miles southeast of and suburban to Melbourne (q.v.). It is a separate municipality and in 1879 was made a city. Pop. (1911 census) 45,367.

PRAIA, prä'yä, or La Praia, Cape Verde Islands (q.v.), since 1770 capital of this group of 14 Portuguese islands; on the southeast coast of the island of São Thiago, the largest and most populous of the 14. It has a good harbor and commercial relations with all the cities of the islands. It is the seat of the governor-general, whose palace is located there; has a meteorological observatory; and is an important cable station between South America, Europe and West Africa. Pop. 21,000.

PRAIRIE, a treeless region in the Mississippi Valley, adjacent to the forested area, so called since the time of the early French explorers. The eastern border of the prairie region is an irregular line crossing Minnesota and Wisconsin in a southeasterly direction and extending into western Indiana, thence crossing Illinois and Missouri southwesterly to the borders of Oklahoma and eastern Texas. From this forest line the prairies extend westward from 200 to 600 miles to the Great Plains, into which they merge quite imperceptibly. In general we may say that the characteristics of the prairies are intermediate between those of the adjacent forests on the east and the plains on the west. The soil, climate, rainfall, etc., of the prairies are much like those of the western edge of the forests. As we go westward the soil becomes more sandy, the climate more «continental» and the rainfall less, approaching the conditions which prevail on the plains.

The soil of the prairies is usually dark in color and rich in organic matter. It is composed of very fine particles, and when dried after wetting becomes very hard. It contains much finely divided sand, and is generally somewhat deficient in clay. While very rich and often of great depth, it is by no means inexhaustible, and the better classes of farmers have found it profitable to add fertilizers from time to time.

The climate of the prairies is somewhat more severe than that of the adjacent forest areas, on account of the free sweep of the winds which intensify the cold of winter as well as the heat of summer. The annual rainfall is about 30 inches, diminishing somewhat as we go westward, and this is so distributed that by far the greater portion falls in the spring and summer.

Although the prairies are usually spoken of as treeless, this is not strictly true, since the streams are always fringed with trees, the treeless areas extending over the higher lands from stream to stream. Yet since these forest fringes are often confined to the deep narrow valleys in which the streams flow, they are often scarcely noticeable as one looks over the landscape. The vegetation of the prairies naturally divides itself into that of the open country and that of the woodlands. In the open country the grasses constitute the dominant vegetation, since they are mostly perennial, and very tenacious of life. The species which are most common are grama (*Bouteloua oligostachya, B. curtipendula, B. hirsuta*), buffalo grass (*Bulbilis dactyloides*), dropseed grass (*Sporobolus*, of several species), wild June grass (*Koeleria cristata*), blue-stem (*Andropogon*, of several species), switch grass (*Panicum virgatum*), beard-grass (*Aristida*, of several species), Muhlenberg grass (*Muhlenbergia*, of several species), sand-grass (*Calamagrostis*), porcupine-grass (*Stipa spartea*), Eaton grass (*Eatonia*), spear-grasses (*Poa*), fescue grasses (*Festuca*), brome-grasses (*Bromus*), wheat-grasses (*Agropyrum*), and wild-rye (*Elymus*), each of many species. Altogether about 150 native species of grasses grow upon the prairies, affording fine pasturage and hay for stock. In those portions of the prairies where the rainfall is abundant these grasses constitute a continuous sod which completely covers the surface, but where there is less rain they are in isolated clumps or bunches, and are then called «bunch grasses.» In all prairies there are other plants which grow intermingled with the grasses, the most conspicuous of which are the golden-rods (*Solidago rigida, S. serotina, S. canadensis*, and other species), asters (*Aster patens, A. sericeus, A. multiflorus*, and other species), sunflowers (*Helianthus annuus*, and other smaller species). A few shrubs are found scattered over the prairies, adding to the variety of the vegetation, most noticeable the wild roses, redroot (*Ceanothus*), and shoe-string (*Amorphia canescens*), the last so-called on account of its long tough roots which trouble the plowman.

The woodlands are usually found bordering the water courses. In some cases they constitute broad areas extending for many miles on each side of the streams, while in others they are narrow belts but a few rods in width, or even mere fringes along the stream-banks. The trees of the prairies are all of species which have wandered away from the eastern forests, and pushed up the streams to a greater or less distance. There are more species along the eastern side of the prairies, and their number decreases as we go westward. The common species are oaks, hickories, walnuts, willows, cottonwood, elms, maples and ashes. As a rule, these trees are not as tall as those which occur in the heavy forests eastward, and they generally grow with more spreading tops. Occasionally, however, trees of gigantic dimensions are found in sheltered situations. Careful observation of the trees on the prairies shows that where they are protected from fires, stock and other adverse influences, they generally reproduce so rapdily as gradually to extend the forest areas. In many places the forest belts along the streams are widening, and also pushing up the valleys. Since the stoppage of prairie fires this natural spreading of the forests has gone on rapidly, so that there is to-day more forest-covered land in some parts of the prairie country than when it was first visited by white men. The prairie lands are from 300 to 1,400 feet above sea-level and are broken by river channels which have been cut in places to depths of over 100 feet.

PRAIRIE CHICKEN, or **PINNATED GROUSE**, a familiar western gamebird (*Tympanuchus americanus*). The genus *Tympanuchus* (or *Cupidonia*) is particularly well characterized by a large patch of naked yellow skin on each side of the neck, ordinarily concealed by a tuft of narrow-pointed feathers attached to the skin at its anterior border. Beneath this patch is an air-sac connected with the respiratory system and which can be inflated until the skin is distended to the size and form of half an orange. The head-crest is small, the tail is rather short, rounded and formed of 18 rather stiff quills, and the tarsi are incompletely and lightly feathered to the toes, which are naked and conspicuously webbed at the base. The plumage is plain, the colors being various browns and yellows with white and black, finely mottled above and more boldly barred transversely below. The neck-tufts of the male are two and one-half to three and one-half inches long, those of the female being considerably shorter. A full-grown male prairie-chicken is fully 18 inches long, but the females are smaller.

The changes in the centre of population of the prairie chicken as related to human settlement of the country are interesting and still in progress. Formerly it ranged throughout all open country between the Appalachian and the Rocky Mountain systems, and from Manitoba to the Gulf Coast. As the country has become more thickly populated it has disappeared from many regions and the eastern limit of its range has moved more and more westward. At the same time the clearing of the forests has provided much new open country which it has been prompt to occupy, replacing other species of grouse less adapted to life on bare prairies, and becoming abundant in many places where, as in parts of Minnesota, the land is cultivated in large tracts. In this way its range has extended westward and northward as it has been curtailed eastward. Like most of the grouse the prairie chicken is gregarious, living in flocks which become very large in the winter, when the birds show a disposition to wander. Throughout most of its still wide range this species is not in any true sense migratory; but a definite northward and southward movement takes place in the upper part of the central Mississippi Valley, although according to some experienced gunners and ornithologists, this is limited to the females, the males being quite stationary. In the spring parties of the males congregate at dawn on knolls, perform various antics, and from time to time inflate and empty the air-sacs, thus producing a loud booming noise which is said to be audible, in the stillness of the time and place, for a mile. In a few days the females gather, when the cocks engage in fierce battles for the possession of mates, before whom they strut and swell, with drooping wings and spreading tail, with their Cupid's wings elevated and air-sacs inflated almost to bursting, until the conquest is complete. They are monogamous and the nest of grass and weeds is built in a concealed spot on the ground and from 12 to 20 eggs, of a grayish or buff color and either unmarked or speckled with brown, are laid. They are said to hatch in about 25 days and the young, which run at birth, are cared for chiefly by the female, which has also performed the labor of incubation. Throughout the summer and early autumn they remain in family parties, but later gather in larger flocks. The food consists of various kinds of berries, nuts, seeds, shoots and buds and insects. With the development of the prairie region as a great grain-growing country the prairie chicken has come to be especially abundant in the cultivated districts and to adopt wheat and other grains as special articles of diet. The vast numbers of grasshoppers which they destroy should, however, more than compensate the farmer for any loss of grain which he suffers.

The prairie chicken is so prolific, that, in spite of the enormous numbers destroyed annually by cold rains, hawks, skunks and other natural influences, and by man, it has held its own and continues to be abundant in many parts of the grain-producing prairie States. It is, therefore, of far greater commercial importance than all other species of our native grouse combined, and not only are immense numbers consumed within those States but many thousands are shipped to New York and other eastern markets, where its rich and delicate flesh is in demand for table use. Most States have seen the expediency of establishing close seasons and of prohibiting the use of snares and traps in its capture, so that it is now hunted almost exclusively with the shot-gun. Many States have also prohibited its shipment for sale and have limited the number which a gunner is permitted to shoot in one day, usually to 25 or 50. Naturally it is the great game bird of its range. Its great popularity with the masses, however, is probably due to the size of the bag which results from a day's shooting rather than to its gaming qualities, for in speed and other attributes which test the true metal of the sportsman the prairie chicken cannot compare with the ruffed grouse. Early in the season, when the young are not yet strong of wing and when better cover and warm weather cause the birds to lie close, bags of 50 or even 100 may be made by a good shot on the best hunting-grounds, but with the advance of the season and cooler weather the birds become more alert, harder and swifter of wing, the long quick shots which are now necessary testing the skill of even the most experienced gunner. Still later nothing but the rifle and much hard tramping is likely to yield any returns. As in the case of all similar gallinaceous birds, a strong shooting gun and good dogs are required. Whether the latter be setter or pointer is generally immaterial, as both may be equal in speed, ruse and training. For this work on the wide, little watered prairies, endurance is a prime qualification and many hunters use their dogs in relays. The best time for the sport is in the early morning and late afternoon, not only because tramping under the noonday sun is very wearying to hunters and dogs, but also because the birds cease feeding at that time and retire to sheltered gulleys and ravines. The species is easily domesticated.

It is very commonly stated that the prairie chicken was found throughout the New England and Middle States a century ago; but ornithologists are now practically agreed that the eastern heath hen is a distinct species, properly called *T. cupido*. At one time it was common, but became practically extinct 75 years ago. At the present time the only colony known to be in existence is one which inhabits the wooded hills and scrubby plains of the island of Martha's Vineyard, where the birds are seldom seen in the thick coverts which this region affords. In general habits the heath hen differs little from its western relative. This remnant of its race is absolutely protected by the Massachusetts game law and a generally sympathetic local sentiment. A third species (*T. pallidicinctus*) is found in the region from Kansas to Texas, and along the Gulf Coast the common prairie chicken develops a distinct local race in Texas and Louisiana. In parts of the northwest the sharp-tailed grouse (*Pediocætes phasianellus*) is called prairie-chicken. See Grouse.

Consult Baird, Brewer and Ridgway, ‹Birds of North America› (Boston 1887); Sandys and Van Dyke, ‹Upland Game Birds› (New York 1902); Coves, ‹Birds of the Northwest› (Washington 1874); Leffingwell and others; ‹Shooting on Upland, Marsh and Stream› (Chicago 1890); Elliot, ‹Gallinaceous Game Birds of North America› (New York 1897); Elliot, ‹Monograph of the Tetraonidæ› (New York 1872); Palmer and Olds, ‹Digest of Game Laws,› Bulletin No. 16, Div. Biological Survey, United States Department of Agriculture, Washington 1902.

PRAIRIE DOG, a name given to either of the two species of marmot-like rodents of the western plains of the genus *Cynomys*, but especially to *C. ludovicianus*. It is about a foot long, reddish-brown above, lighter beneath. Its habits are eminently social. It forms large communities on the higher and drier parts of the plains, each burrow having a little hillock at its entrance, forming a firm curb about the shaft, which leads steeply down to a series of chambers a dozen feet or more underground, where the animals spend the winter in comfort, sustained by a store of the stems and seed-heads of sunflowers and similar plants.

These colonies were naturally several acres in extent, forming «towns» of crowded burrows; and were frequented by weasels, wolves, badgers, snakes and birds of prey, which preyed upon the rodents and their young, and kept down their numbers. Since the general settlement of the borders and river-valleys of the plains region, the prairie dogs have been so favored by the decrease of their natural enemies and by the spread of irrigated cultivated lands, supplying them with both water and food in vast abundance, that they have increased enormously, so that at the opening of the present century areas of thousands of square miles in northern Texas, and in the region between the upper Arkansas and Platte rivers, were so infested with the animals as to be practically useless to man. The question of practical relief from this condition has been a subject of much discussion among naturalists, not only, but both general and local governments have been forced to act in assistance of the farmers and cattlemen. The most successful means of extermination seems to be suffocation in their holes by means of bisulphide of carbon, which is placed upon balls of absorbent material and rolled down their burrows. Consult publications of the United States Department of Agriculture since 1891.

PRAIRIE DU CHIEN, Wis., city, county-seat of Crawford County, on the Mississippi River and on the Chicago, Missouri and Saint Paul and the Chicago, Burlington and Quincy railroads, about 90 miles in direct line west of Madison. In the vicinity of the city of mineral springs. Previous to its settlement the ground on which the city stands now was open prairie land. It is said that it was then the seat of an Indian chief named «The Dog,» from which the French gave it its present name. Prairie du Chien was settled in 1783, but a French fort was built here in 1685 and abandoned a few years later. Another fort was built in 1755. In 1786 the British surrendered this place to the United States, but captured it again in 1814 and retained possession for two years. In 1872 it was incorporated. Prairie du Chien is the trade centre of a fertile agricultural section. The chief manufactures are pearl buttons, barrels, veneer, egg cases, woolen goods, pickles, dairy products. The trade is chiefly in eggs, poultry, farm and dairy products, buttons and its own manufactures. The principal public buildings are the churches and schools; the ruins of Fort Crawford (1830) still remain. The educational institutions are College of the Sacred Heart, for boys and young men; Saint Mary's Institute, for girls; a high school, public and parish schools and a public library. The population in 1910 was 3,149. Consult ‹State Historical Society of Wisconsin Collections› (Madison 1855–1916).

PRAIRIE FOX, the swift or kit fox (*Vulpes velox*) of the western American plains. See Fox.

PRAIRIE GROVE, Battle of, an engagement between the Confederates under General Hindman and the Federals under Gens. F. J. Herron and J. G. Blunt, at Prairie Grove, Ark., 7 Dec. 1862. Blunt had been stationed for some time at Cane Hill, when he received information that Hindman, with a force of about 25,000, was advancing northward to enter Missouri. He immediately summoned Herron and his two divisions, then near Springfield, Mo., to his aid. Herron reached Fayetteville, about 12 miles from Blunt's position, in the morning of 1 December, and the Confederates at that time lay between the two Union camps. Early that morning Hindman, with 11,000 men, moved against Herron; the Confederate cavalry at first had the advantage, but were in turn driven back by Herron, whose entire force came up; Hindman then took up a strong position and awaited attack. Meantime Blunt hastened to Herron's aid, and Hindman thus faced a force superior to his own in both numbers and equipment. The battle lasted the greater part of the day, and the Confederates were finally forced to retreat. The Confederate loss in killed, wounded and missing was 1,317; the Federal loss, 1,251. The battle was of importance as checking the further advance of the Confederates into Missouri. Consult ‹The War of the Rebellion› (Series I, Vol. XXII, Part 1, pp. 67–158, Washington 1888).

PRAIRIE HEN. See Prairie Chicken.

PRAIRIE PIGEON, name given in the prairie region of the western United States to both the golden plover and the upland plover. See Plover; Sandpiper.

PRAIRIE RATTLESNAKE, a name applied to one of several rattlesnakes to be found on the prairies of North America, the massasauga (*Sistrurus catenatus*). See RATTLESNAKE.

PRAIRIE SCHOONER, a type of covered wagon, used by the pioneers in transporting their chattels across the western prairies. As a type they have vanished, but the covering of the modern army motor truck is arranged in many respects similarly to that of the early prairie-schooner — more or less of a horseshoe shape with openings in front and back.

PRAIRIE SQUIRREL, or GOPHER, a name for several animals of the genus *Spermophilus,* found in the American prairies in great numbers. See GOPHER.

PRAIRIE STATE, a name applied to Illinois from the fact that the face of the State is mostly a level table-land, elevated from 300 to 800 feet above the sea.

PRAIRIE WOLF, the coyote (q.v.).

PRAISE OF FOLLY, The (‘Moriæ Encomium’), «the wittiest of all Erasmus's writings» (Froude), was written at Sir Thomas More's house in Bucklersbury immediately after Erasmus's return from Italy in 1509, but was not published until two years later when Erasmus went to Paris to see it through the press. At least 12 editions followed within the next 10 years; and several English translations quickly appeared, so that Milton in 1628 speaks of it as being «in everyone's hands» at Cambridge. In a dedicatory letter to More, Erasmus tells us that «the first hint (of the work) was your own surname of More, which comes as near the literal sound of the word (*Moria*) as yourself are distant from the signification of it, and that in all men's judgments is vastly wide.» From a subsequent letter to John Botzheim (1523) it appears that Erasmus had intended at the same time to write three essays in praise of Folly, Nature and Grace, respectively, but that the carping disposition of certain persons made him change his mind. ‘The Praise of Folly,’ which is very entertainingly written and is filled with proverbs, classical allusions and quotations from the poets, scourges the abuses and follies of the various classes of contemporary society, although not by lashing particular persons by name. «I did not,» Erasmus tells us, «so far imitate Juvenal as to rake into the sink of vices to procure a laughter rather than create a hearty abhorrence.» The entire work is put into the mouth of Folly herself, who, after describing her descent, education and attendants, proceeds to show that no class of human beings is free from her influence. In this process, it is shown tc what extent grammarians and poets, philosophers and theologians, religious and monks, princes and courtiers, popes, cardinals and bishops and all other classes of men are under Folly's sway. The work is comparatively free from the coarseness of speech prevalent at the time, and men like More said that it needed no defense. It has been charged, however, that it was a deliberate attempt to discredit the Church, but this charge is unfounded, unless by the words «the Church» one means «the wicked and unfaithful ministers of the Church.» Among these indeed it produced consternation, although its author did not incur the disfavor of secular princes, many fellow-clerics and even Pope Leo X. Hard as he had struck at the existing evils he had said nothing for which the Church courts could openly punish him. When it is remembered that ‘The Praise of Folly’ appeared after the pontificates of such Popes as Alexander VI and Julius II, at a time when simony and similar abuses had made such an inroad into the Church that plans were laid for convening the great reformatory Council of Trent, it is not difficult to imagine that such outspoken works as the one under discussion were needed to speed the day.

HERBERT F. WRIGHT.

PRAISES OF THE CREATURES, The. See CANTICLE OF THE SUN.

PRAJĀPATI, Hindu divinity, having the character of a creator; at various periods this name was given to different Hindu deities, such as Indra, Brahma, etc. Thus there were many Prajâpatis, and the Puranas contain many legends concerning them. Consult Monier-Williams, Sir M., Brahmanism and Hinduism’ (4th ed., London 1891); Barth, A., ‘The Religions of India’ (Boston 1882); Hopkins, E. W., ‘The Religions of India’ (Boston 1895); Macnicol, N., ‘Indian Theism’ (London 1915).

PRĀJÑĀ PARAMITĀ, the principal Sutra (body of rules or precepts) of the Mahayana School of Buddhists. The words mean in Sanskrit «absolute or transcendental wisdom.» Consult Walleser, M. G. L., ‘Prajña Pāramitā; Die Voll Korumeubeit der Erkeuntris’ (in Quellen der Religions-Geschichte,’ Vol. VI, Göttingen and Leipzig 1914).

PRAKRIT LANGUAGES AND LITERATURE. The term Prakrit is applied to the vernacular languages of India, in distinction from the literary idiom, the Sanskrit (*samskrita,* purified, refined; *prakrit,* natural, common), and it is a sign of the venerable age of Prakrit that we find traces of it even in some very early Vedic hymns. Prakrit again is subdivided into primary, secondary and tertiary, according to the period when each of these three forms of the vernacular was in general use. There are two main groups of primary Prakrit, namely, the Aryâvarta, or that spoken in the central part of India, the Mâdhya-dêsa, and that current in the zone beyond, the so-called «Outer Band.» That of the Midland developed in its turn into literary Sanskrit about B.C. 300. Irrespective of that process, however, the primary Prakrits arose and grew in accordance with the usual courses of phonetics, with a general tendency to simplify the different idioms, eliminating harsh consonants and diphthongs and also complicated grammar forms. Side by side, however, with the literary Sanskrit there developed in the central region of India a vernacular, though this was somewhat hampered in its growth by the literary tongue. One of the secondary Prakrits at least, the Pâli, grew into the literary vehicle of Buddhism and became a highly articulated tongue. Besides, other Prakrits in a measure went through the same process and blossomed out into literary languages, both for profane and sacred uses. Thus, Jainism (or the Jaina religion, a regenerated Brahmanism) was propagated by three distinct Prakrits, and in the Indian drama and in other branches of literary production some of the common dialects were likewise employed. Singularly enough, in such dramas the Brahmans, heroes and persons of high lineage and the female personages, the celestial nymphs, courtesans, etc., only, spoke generally in Sanskrit to the audiences, all the others in the various forms of Prakrit. In fact, our knowledge of the older Prakrits has been greatly enhanced by this Indian stage convention, because the vernaculars thus employed in plays by acting persons varied greatly, partaking as they did of the provincial character assumed by each. Often as many as 10 different forms of Prakrit are thus introduced in a single play to the audiences, and of some of the less prominent Prakrits, notably of those possessing no literature of their own, we should not have a single trace without the aid thus given our understanding. Distinguished again from Prakrit proper, or perhaps rather as its lowest expression, is the *Apabhramsa* («corrupt» language, or «patois»), a name given to the wholly unliterary form of Prakrit, the one quite devoid of grammatical niceties and ingenious refinements of speech. However, it might happen that the Apabhramsa itself grew into a literary vehicle and received a grammatical construction, while a coarser form of the same vernacular remained as the speech of the totally uncultured masses. The secondary Prakrits again attained a double growth, that of the Mâdhya-dêsa, or Midland region of India, which was named *Sauraséni,* and that of the surrounding country district. Sauraséni extended as far as Lahore, overrunning Rajputâna and Gujerât. Its vocabulary was nearly identical with the primary Prakrit, but phonetically there was considerable change. The Prakrits of the Outer Band comprised the Mâgadhi, Ardhamâgadhi and Mâhârâstri. Pâli grew out of Mâgadhi. Ardhamâgadhi (half Mâgadhi) developed by itself. Mâhârâstri was spoken and cultivated in the large kingdom of that name, reaching from the Nerbudda to the Kistna and including parts of Bombay and Hyderabad, all of it south of the Sauraséni territory. At one time the prevalence of Prakrit of the Outer Band extended up to and including Benâres. As a general point it ought to be noticed that there was an Apabhramsa (corruption) to each proper form of Prakrit. But uniform with them all, Prakrit and Apabhramsa both had the inclination to do away with certain harsh consonantal sounds that existed in literary Sanskrit itself, and with as much grammatical restriction as possible. Thus, for example, the Sanskrit *bratam* (brother) develops into *vatam* in Pâli and into *vaam* in Mâhârâstri. A number of the Prakrits, too, cast out the Sanskrit *r*. Of all these Prakrits it is Mâhârâstri that deserves most mention. In the Indian texts it usually stands for Prakrit *per se*. It obtained literary prominence quite early, epical, lyrical and dramatical literature being alike cultivated. Ardhamâgadhi also produced much literature, though of a somewhat inferior texture. However, the early Jaini books were composed in it. Sauraséni is, on the other hand, the usual prose dialect of the plays and is also used exclusively by one of the Jaini sects in their writings. There is, then, a plentitude of material from which to study the earlier as well as the later Prakrits, and there are grammars, too, to help. Throughout one notices a steadily proceeding decay of grammatical rules and forms in all the Prakrits, until, as in the Hindustani of to-day, a purely analytical vernacular is the result. In their general phonetic effect there was a flattening of the vowels and a pruning away of superabundant consonants. To be more explicit as to the poetical and literary uses made of the Prakrits, the holy writings of the Jaina religion, the *sûtras,* etc., were in Ardhamâgadhi; the non-canonical books of the Svêtâmbara sect were in Mâhârâstri, and the canon of the Digâmbâras was in Sauraséni. In lyrics, which all are of a highly artificial type, the Prakrit reigns supreme. Most admired by Indians is Hâla's «Sattasaī,» a collection of lyrics compiled some time before the 7th century A.D. There is much grace and playful fancy displayed in this collection, though in range of subjects and thought somewhat narrow. Many imitations inspired by this volume have appeared in India, the best being probably the «Satsaī,» of Bihâri Lâl (17th century). The sources whence Hâla drew are, unfortunately, lost. It has been contended that the «Mahâbhârata» also owed much to Prakrit, and that it had first been written as a folk-epic in the early vernacular before being done over into Sanskrit proper. Mâhârâstri was employed for lyrics, even in Sanskrit dramas, as Sauraséni was for most interspersed dialogue. In Prakrit epic poetry the «Ravânyavâha» (Death of Ravâna), based on the «Rāmāyana» of Pravarasêna (about A.D. 700) occupies first place. Since then the «Gaûdavaha» by Vākpabi (about 750 A.D.), telling of the taking of Bengal by Yasōvarman, and the «Kumārapāla-carita» (A.D. 1150) are the most pretentious. Of Prakrit dramatic literature may be mentioned the «Karpûra-mānjarī,» a lively comedy of intrigue (A.D. 900) by Rājasekhara; in fiction «Kathâsaritsâgara,» a tale of adventures by Somadra, and «Gitagōvinda» by Jayadeva, a fanciful narrative may be cited.

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WOLF VON SCHIERBRAND,
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PRAM, prăm, **Christen Henriksen**, Danish poet, critic and economist: b. Gudbrandsdalen, Norway, 4 Sept. 1756; d. island of Saint Thomas, West Indies, 25 Nov. 1821. He studied at Copenhagen and in 1781, as a member of the agricultural and commercial college of Copenhagen, he undertook several tours, the results of which were published in the *Commercial Journal*, founded by him in 1782. In 1815 he was discharged from his office with a small pension, and in 1819 became collector of customs on the island of Saint Thomas. His numerous writings embrace a great variety of subjects, both in political and natural science. Among his poetical productions are ‘Heroide an Erich’; and ‘Starkodder’ (Copenhagen 1785), a heroic poem, in 15 cantos. He also edited J. H. Wessel's ‘Collected Writings’ (1787). Besides the *Commercial Journal* he founded another, the *Minerva*, a critical monthly which rendered essential service in the formation of literary taste in the Scandinavian kingdoms. As editor of the latter he was succeeded by K. L. Rahbek, who edited and published his ‘Works’ (six vols., 1824–29). Consult Host, J. K., ‘Til Christensen Henriksen Prams Amindelse’ (Copenhagen 1820).

PRANG, prăng, **Louis**, German-American engraver and publisher: b. Breslau, Germany, 12 March 1824; d. Los Angeles, Cal., 15 June 1909. His part in the revolutionary movement of 1848 compelled him to leave Germany and he came to this country in 1850. He established himself as a wood engraver in Boston, later becoming a lithographer, and in 1861 engaged in publishing, making a specialty of color printing. He was especially known for his well-executed reproductions of famous paintings. He invented the Prang method of art instruction and published the drawing books and materials used in that course. He was president of the Prang Educational Company of Boston and of the Taber-Prang Art Company of Springfield, Mass. He published ‘The Prang Standard of Color’ (1898); and with John S. Clark and Mary D. Hicks, ‘Suggestions for Color Instruction’ (1893).

PRASE. See Quartz.

PRATER, prā'tĕr, the most famous promenade of Vienna. See Vienna.

PRATI, Giovanni, jō-vän'nē prä'tē, Italian poet: b. Dasindo, near Trent, 27 Jan. 1814; d. Rome, Italy, 9 May 1884. He studied law at the University of Padua, from which he was graduated in 1834, but soon turned to literature. Strongly anti-Austrian and deeply in sympathy with the movement for national independence and unity under the rule of the royal house of Savoy, he was frequently in political difficulties during the period of Italy's unification. He lived successively in Milan, Turin, Florence and Rome. His first major work, ‘Edmenegarda’ (1841), a narrative poem of the Romantic school, was received with extraordinary favor. Several volumes of lyric poetry still further increased the poet's reputation, but during the last years of his life he wrote but little. In 1862 he was elected to the Italian Parliament and in 1876 became senator. He was a prolific writer of rather uneven merit. Endowed with rich imagination and facility of style and expression, he was lacking in originality and depth. Some of his lyric poems are amongst the best of his time, but much of his work is mediocre. His works include ‘Canti Lirici, Canti per il Popolo e Ballate’ (2 vols., Milan 1843); ‘Lettere a Maria’ (Turin 1843); ‘Memorie e Lacrime’; ‘Nuovi Canti’ (Turin 1844); ‘Poesie’ (Palermo 1844); ‘Nuovi Versi’ (Venice 1848); ‘Poesie Politiche’ (Italia 1850); ‘Rodolfo’ (Turin 1853); ‘Satana e le Grazie’ (Pinerolo 1855); ‘Ariberto’ (Turin 1860); ‘Armando’ (Florence 1868); ‘Psiche’ (Padua 1876); ‘Iside’ (Rome 1878). A collection of his works was published as ‘Opere Varie’ (5 vols., Milan 1875). Consult Zanichelli, D., ‘La Rivoluzione de 1848 e le Poesie Politiche di G. Prati’ (Bologna 1895); Cavalluzzi, C., ‘La Poesia del Prati’ (Citta di Castello 1898); Emmert, Bruno, ‘Saggio Bibliografico; Giovanni Prati’ (in ‘Atti della R. I. Accademia di Scienze Lettere ed Arti degli Agiati in Rovereto,’ serie III, Vol. 17, pp. 173 and 285, Vol. 18, p. 89, Rovereto 1911).

PRATINAS, Greek poet: flourished about 500 B.C. He was a native of Phlius in the Peloponnesus and became famous as a lyrical and dramatic poet. He is credited with originating the satyric drama which he introduced at Athens. Fragments of his lyrical poetry have been collected and published by T. Bergk in ‘Poetæ Lyrici Græci’ (Leipzig 1843); Nauck, A., ‘Tragicorum Graecorum Fragmenta’ (Leipzig 1856).

PRATINCOLE, a genus *Glareola* of wading birds of the family *Glareolidæ*, allied to the plovers, inhabiting the temperate and warmer regions of the Old World. About half a dozen species are described in Europe, Asia, Africa and Australia, frequenting the borders of rivers, lakes and marshes in low and high regions; the food consists of worms and insects, which they pick from the ground or aquatic plants or take on the wing like swallows; they fly and run very swiftly; the nest is a slight structure on the ground, among the thick herbage of the marshes, and the eggs three or four in number. All scream noisily. The collared pratincole (*G. pratincola*, Pall.), plentiful in southern Europe, is about the size of a blackbird, nine inches long; it is brown above, white on the rump and below; the throat surrounded by a black circle; the base of the bill and the feet reddish.

PRATIQUE, prat'ēk, a term used to signify the permission given to a vessel to hold communication with the land after the port authorities have been satisfied that the ship is free from infectious diseases. See Quarantine.

PRATO, prä'tō, Italy, city in the province of Florence, on the Bisenzio, 11 miles northwest of Florence, with which it is connected by a railroad and a street railway. It is surrounded by ancient walls and is a well-built, cheerful-looking place. The cathedral, begun in the 12th and finished in the 15th century, with a very beautiful open air pulpit by Donatello and Michelozzo, contains also some very fine frescoes by Fra Filippo Lippi (q.v.). Amongst the other memorable buildings are a court of justice, several other churches, monasteries, convents, an old castle, an ancient prætorium (Palazzo Pretorio), a college, called after its founder Cicognini, a public library, a theatre and several hospitals. Its extensive manufactures of woolen, silk, straw hats, paper, candles, olive oil, crackers, clothing and furniture, together with its iron and copper works have made Prato a prosperous, up-to-date city. It is the seat of a bishop. Pop. (1910) 20,360 (city proper); 56,715 (commune).

PRÄTORIUS, prā-tō'rē-ŭs, **Michael**, German composer: b. Kreuzberg, Thuringia, 15 Feb. 1571; d. Wolfenbüttel, Brunswick, 15 Feb. 1621. Details concerning his life are very meagre. He began his career as kapell-meister at Wolfenbüttel, was secretary to the Duke of Brunswick, and later was appointed prior of the monastery of Ringelheim, near Gozlar, with the privilege of making his residence where he chose. He was one of the most prominent composers of his time and also an able writer on musical topics. His most noted literary work is ‘Syntagma Musicum’ (Wolfenbüttel 1614–20), and his compositions include ‘Musæ Sioniæ’ (published in 16 volumes, containing 1,244 vocal numbers, Wolfenbüttel 1605–10); ‘Musa Aonia’ (9 vols.), etc. His works are now exceedingly rare. A detailed description of the contents of ‘Syntagma Musicum’ may be found in ‘Grove's Dictionary of Music and Musicians’ (Vol. III, p. 806, New York 1911).

PRATT, Ambrose, Australian journalist and author: b. Forbes, New South Wales, 31 Aug. 1874. He was graduated in law from Sidney University, but he soon left his profession to join the editorial staff of the Melbourne *Age* (1905). His published works include the following: ‘King of the Rocks’ (1900); ‘The Loot of the Tien-ti-Hway’ (1900); ‘Franks, Duellist’ (1901); ‘The Great Push Experiment’ (1902); ‘Vigorous Daunt, Billionaire’ (London 1903; New York 1904); ‘Three Years with Thunderbold’ (1905); ‘The Countershake’ (1906); ‘The Remittance Man’ (1907); ‘The Emperor and his Double’; ‘First Person Paramount’ (1908); ‘The Veiled Man’ (1909), and many short stories.

PRATT, Anne, English botanist: b. Strood, England, 5 Dec. 1806; d. London, England, 27 July 1893. She made a life-study of the nature of plants and her writings reveal a wide knowledge as well as a deep love of nature. Her books are illustrated with her own excellent sketches and achieved great popularity. She had the happy faculty of combining a popular style with a considerable amount of scientific accuracy, so that her books served not only the purpose of increasing popular interest in botany, but also added considerably to the sum total of knowledge regarding English plants, grasses, etc. The most important of her books, all of which were published in London, are ‘The Field, the Garden and the Woodland’ (published under the pseudonym ‘A Lady,’ 1838); ‘Flowers and their Associations’ (1840); ‘Dawnings of Genius, or the Early Lives of Some Eminent Persons of the Last Century’ (1841); ‘The Pictorial Catechism of Botany’ (1842); ‘Chapters on Common Things of the Seaside’ (1850); ‘Our Native Songsters’; ‘The Green Fields and their Grasses’; ‘Wild Flowers’ (2 vols., 1852); ‘Flowering Plants, Grasses and Ferns of Great Britain’ (5 vols., 1854); ‘The Ferns of Great Britain, etc.’ (1855); ‘The Poisonous, Noxious and Suspected Plants of our Fields and Woods, etc.’ (1857); ‘The British Grasses and Sedges, etc.’ (1859); ‘Haunts of the Wild Flowers’ (1863). She also translated Ottilie Wildermuth's ‘Im Tageslicht’ and published it in 1865 under the title ‘By Daylight.’

PRATT, Bela Lyon, American sculptor: b. Norwich, Conn., 11 Dec. 1867; d. Boston, 19 May 1917. He studied at the Yale School of Fine Arts under Niemeyer and Wier, and at the Art Students League in New York under Augustus St. Gaudens, F. Edwin Elwell, William Chase and Kenyon Cox, working under St. Gaudens in his studio. Later he studied in Paris under Chapu and Falquière and at the École des Beaux Arts. He received two medals and two prizes while in Paris and in 1892 he returned to the United States. He has been instructor of modeling at the Boston Museum of Fine Arts since 1893. He has produced many works in sculpture, including statues, memorials, portrait busts, tablets, medallions and other works. He is a member of the National Institute of Arts and Letters, the American Academy of Arts and Sciences and of the National Sculptors Society. He was awarded a gold medal at the Panama Exposition in 1915. Among his works may be mentioned two colossal groups on the Water Gate of the Peristyle at the Chicago Exposition: the Eliot medal for Harvard University and the Yale Bi-centennial medal; six seven-foot spandrel figures for the main entrance of the Library of Congress, as well as a 12-foot figure of ‘Philosophy’ and a series of four medallions, ‘The Seasons’ there; recumbent figure of Dr. Coit, Saint Paul's Church, Concord, N. H., which received honorable mention at the Paris Salon in 1897; ‘Study of a Young Girl,’ second medal at the Buffalo Exposition in 1901; statues of Bishop Brooks, Gov. John Winthrop, Jr., General Stevenson and others; portrait busts of Gen. C. J. Paine, Bishop Huntington, Dr. Homans, Dr. Richard Hodgson; the Harvard Spanish War Memorial; statue of Nathan Hale, Yale Campus, etc.

PRATT, Charles, American philanthropist: b. Watertown, Mass., 2 Oct. 1830; d. New York, 4 May 1891. He obtained a portion of his education at Wesleyan Academy, Wilbraham, Mass., after having saved the money needed by working as a machinist, and in 1851 removed to New York where he engaged with a paint and oil firm, of which he became a member in 1854. When the firm dissolved in 1867 he retained the oil interests and under the firm name Charles Pratt and Company organized a most successful business. He grasped the possibilities of the petroleum trade when the oil fields of Philadelphia were being developed in 1860 and devoted himself to producing the best quality of refined petroleum on the market, Pratt's astral oil becoming world-famous. He acquired an enormous fortune and in 1874 his business was merged in the Standard Oil Company, with which concern he was, therefore, affiliated almost from its beginning and in the prosperity of which he shared to a very considerable extent. He afterward devoted himself to philanthropic enterprises and contributed generously to various religious, charitable and educational causes. His greatest philanthropic work was the founding of the famous Pratt Institute (q.v.) in 1886, in which he embodied his ideas of a thorough and practical education. It was opened in 1887 with 12 students, a number which at the time of his death had increased to over 3,000. The entire cost of the buildings, equipment, grounds and ample endowment was borne by Mr. Pratt and at his death he left a further endowment of $2,000,000. He was public-spirited in every way but firmly declined public office.

PRATT, Daniel, the «Great American Traveler,» American eccentric: b. Prattville, Chelsea, Mass., about 1809; d. Boston, Mass., 21 June 1887. He was a carpenter by trade, but became mentally unbalanced and wandered about, a pensioner on general charity. Contributions of his, including certain «proclamations,» appeared from time to time in print; and for several years he made annually a grand tour of New England colleges, delivering in each grandiloquent orations. He believed himself unjustly deprived of the Presidency, asserting he had been duly elected.

PRATT, Ella Farman, American writer for young people: b. New York; d. Warner, N. H., 22 May 1907. With C. S. Pratt, for a series of years she edited the juvenile periodical *Wide Awake* and later *Little Folks*. Among her books, many of which were published under her maiden name, are ‹Good-for-Nothing Polly›; ‹How Two Girls Tried Farming›; ‹A Girl's Money›; ‹The Cooking Club of Tu-Whit Hollow›; ‹A Little Woman›; ‹Grandma Crosby's Household›; ‹Mrs. Hurd's Niece›; ‹Anna Maylie›; ‹A White Hand›; ‹Sugar Plums›; ‹Happy Children›; ‹The Play Lady› and ‹The Little Cave-Dwellers.›

PRATT, Enoch, American philanthropist: b. North Middleborough, Mass., 10 Sept. 1808; d. near Baltimore, Md., 17 Sept. 1896. He was educated at the Bridgewater (Mass.) Academy, entered a commercial house in Boston and in 1831 removed to Baltimore where he became a wholesale iron merchant and engaged in various financial enterprises which gained for him great wealth. He presented to the city of Baltimore in 1882 the Enoch Pratt Free Library, endowing it to the extent of $1,145,000. He was one of the first amongst American millionaires to devote part of his wealth to the founding of public libraries. He also gave generously to different churches, libraries and schools, especially to the House of Reformation and Instruction for Colored Children at Cheltenham, Md., and the Maryland School for the Deaf and Dumb at Frederick. The residue of his large estate was left to the trustees of the Sheppard Asylum, a hospital for mental diseases near Baltimore, which is now known as the Sheppard and Enoch Pratt Hospital.

PRATT, George Du Pont, American conservation commissioner: b. Brooklyn, 16 Aug. 1869. He was graduated at Amherst College in 1893 and entered the employ of the Long Island Railroad, eventually becoming assistant to the president of that company. In 1915 he became conservation commissioner for the State of New York and rendered important service in prevention of forest fires and by an education campaign in the field of hunting and forest laws has made great progress in his conservation of the natural resources of the State. Mr. Pratt is also well-known for his philanthropic interests.

PRATT, John Francis, American scientist: b. Pomfret, Vt., 18 June 1848. He was graduated from Dartmouth College in 1871; studied civil engineering and in 1871 became connected with the United States Coast and Geodetic Survey, being made an assistant in 1884. He led the expedition to Chilcoot, Chilkat, Skagway and Dyea to determine the southeast boundary of Alaska; conducted an expedition to the east side of Bering Sea and the lower portion of the Yukon River in 1898. Has commanded several different vessels of the United States Coast and Geodetic Survey in conducting various expeditions to Alaska, Bering Sea, Hawaiian Islands, central portion of the Pacific Ocean and the Philippine Islands. He has recently been appointed on inspection duty in Oregon, Washington and Alaska.

PRATT, Orson, American Mormon apostle: b. Hartford, N. Y., 19 Sept. 1811; d. Salt Lake City, Utah, 3 Oct. 1881. After a common-school education, he followed the lead of his brother, Parley P. Pratt (q.v.), and joined the Mormons in 1830, accompanied them in the westward migration and in 1835 became one of the original 12 apostles. With Erastus Snow he was the first to enter the valley of the Great Salt Lake. From 1840–78 he accomplished eight missions to Great Britain and in 1864–65 one to Austria. During his visits to England he edited at various times *The Millennial Star*, the circulation of which he increased greatly. He began in Washington in 1852 the publication of *The Seer*, a monthly, of which 18 numbers appeared. From 1874 until his death he was historian and general church recorder. He was also for many sessions a member of the Utah Territorial legislature and seven times its speaker. In spite of the lack of educational opportunities which he had experienced in his early life, he became a well-versed scholar of higher mathematics, astronomy and Hebrew. In 1854 he announced his «law of planetary rotation» to the effect that the cubic roots of the densities of the planets are as the square roots of their periods of rotation. Among his works are ‹New and Easy Method of Solution of the Cubic and Biquadratic Equations› (London 1866); ‹Key to the Universe› (1879), and a large number of tracts and pamphlets dealing with the Mormon doctrine. He also edited and published in Salt Lake City *The Doctrine and Covenants of the Church of Jesus Christ of Latter-Day Saints, Containing the Revelations Given to Joseph Smith, Jr., the Prophet.*›

PRATT, Parley Parker, American Mormon apostle: b. Burlington, N. Y., 12 April 1807; d. near Van Buren, Ark., 13 May 1857. He adopted the Mormon faith in 1830 and in 1835 was elected a member of the first quorum of the 12 apostles. He traveled in this country, Canada, South America and in England, engaged in missionary work and in 1840 established at Manchester, England, the *Millennial Star*. At various times he was put in charge of the Mormon churches and missions in Great Britain, New England and the Middle States. He was one of the party which explored the valley of the Great Salt Lake in 1847 and 1849 and Parley's Peak and Parley's Cañon were named in his honor. He assisted in forming a constitution for the Provisional Government of Deseret, the name then applied to the present State of Utah, served as a member of its senate and later, when Deseret became the United States Territory of Utah, as a member of its legislative council. Throughout the early days of Mormonism he suffered all the hardships and persecutions which were then inflicted upon members of his sect and had many narrow escapes from injury and death. At last, while engaged in one of his frequent missionary tours, he was murdered by three men near Van Buren, Ark. He wrote ‘A Voice of Warning’ (1837); ‘History of the Persecutions in Missouri’ (1839); ‘Key to the Science of Theology’ (1854), etc. His ‘Autobiography’ edited by his son, Parley P. Pratt, was published in 1874.

PRATT, Samuel Jackson («COURTNEY MELMOTH»), English author: b. Saint Ives, Huntingdonshire, 25 Dec. 1749; d. Birmingham, 4 Oct. 1814. He was ordained in the English Church, but later went on the stage where his career was not notable and then turned his attention to literature. He was a very prolific writer and his works cover a wide range of subjects. Though undoubtedly possessing considerable literary talent, force of circumstances prevented him from giving sufficient time and effort to his work so that very little of it proved of lasting value. He is by some authorities credited with a translation of Goethe's ‘Sorrows of Werther,’ which, in 1809, was published by a Dr. Pratt. Of his works, many of which were published anonymously, the most important are ‘Tears of Genius’ (1774); ‘Liberal Opinions Upon Animals, Man and Providence’ (6 vols., 1775–77); ‘Apology for David Hume’ (1777); ‘Tutor of Truth’ (3 vols., 1779); ‘Emma Corbett, or the Miseries of Civil War. Founded on some events in America’ (1780); ‘The Fair Circassian,’ a tragedy (1781); ‘Sympathy,’ a poem (1788); ‘Gleanings through Wales, Holland and Westphalia’ (1795); ‘John and Dame, or the Loyal Cottagers,’ a poem (1803); ‘Harvest Home: Consisting of Supplementary Gleanings, etc.’ (3 vols., 1805). In 1808 he edited and published the ‘Cabinet of Poetry,’ containing selections from the poets (Milton to Beattie) with short biographical notices (6 vols.). He also edited ‘Specimens of the Poetry of Joseph Blacket’ (1809) and ‘The Remains of Joseph Blacket’ (2 vols., 1811), and with Dr. Mavor ‘A Collection of Classical English Poetry’ (1813). The epitaph on Garrick's monument in Westminster Abbey is likewise from his pen and perhaps has been criticised and condemned to a greater extent than any of his other writings. Selections from his works were published as follows: ‘Pity's Gift’ (London 1801) and ‘The Paternal Present’ (London 1810). Consult *Blackwood's Magazine* (January 1895, pp. 121–125); *Gentleman's Magazine* (1814, pt. II, pp. 398–399).

PRATT, Silas Gamaliel, American pianist and composer: b. Addison, Vt., 4 Aug. 1846; d. Pittsburgh, Pa., 31 Oct. 1916. He studied in Berlin in 1868–71 with Kullak, Bendel and Kiel and with Liszt and Heinrich Dorn in 1875–76. His first symphony was performed in Berlin in 1871 and in the following year he organized the Apollo Club of Chicago. His opera ‘Zenobia’ was well received on its presentation in 1882; in 1884 he was director-general of the Chicago Grand Opera Festival. In 1890 he accepted an appointment as professor of piano at the New York Metropolitan Conservatory. In 1906 he became president of the Pratt Institute of Music and Art, Pittsburgh, Pa., and in the same year he also organized there the Pittsburgh centre of the American Music Society. He has published numerous songs, part-songs, symphonies, etc., the operas ‘The Triumph of Columbus,’ ‘Lucille,’ ‘Ollanta’ and the symphonic poems ‘America’ and ‘A Tragedy of the Deep.’ He has also written ‘Lincoln in Story’ (1901) and ‘Pianist's Mental Velocity’ (1903).

PRATT, Kan., city and county-seat of Pratt County, 80 miles west of Wichita, on the Atchison, Topeka and Santa Fé and on the Chicago, Rock Island and Pacific railroads. The city is situated in a rich agricultural and stock-raising district and a State fish-hatchery is located here. The population is increasing. Pop. 3,302.

PRATT INSTITUTE, a polytechnic school in Brooklyn, N. Y., established in 1887 by Charles Pratt (q.v.). Its aim is to promote manual and industrial education as well as cultivation in literature, science and art. Its organization includes the following departments: (1) School of Fine and Applied Arts; (2) School of Science and Technology; (3) School of Household Science and Arts; (4) School of Library Science; (5) Department of Education; (6) Department of Physical Education. The regular courses of the institute vary in length; mostly they cover two or three years; the general course in domestic science is only one year, and the general art course four years. Normal courses are given in the schools of Fine and Applied Arts and of Household Science and Arts, evening classes in these two schools as well as in the School of Science and Technology. The library is open for the free use of the public, has a large children's room, and in equipment and management is considered a model library. It contained 114,775 volumes in 1918. The library school offers a one-year general course and provides practice work for students in the library (See LIBRARY SCHOOLS). The institute confers no degrees, but grants diplomas for the completion of any of the normal courses, and gives certificates attesting the completion of the full-time day courses. It occupies 12 large buildings, the main building, the science and technology building, the electrical building, the chemistry building, the machinery building, the household arts building, the practice house, the men's club house, the women's club house, the rest home, the library and the gymnasium. The endowment is large and the tuition fees are small. The productive funds consist of the original endowment made by the founder, to which large sums have been added at various times by members of the Pratt family. The students in 1918 numbered 3,799, including all those in the special and evening, as well as the regular courses. The faculty consisted of 195 members.

PRATZ, Le Page du, lė päzh dü präts, French explorer in the New World: b. Holland, about 1690; d. 1775. Entering the French army and serving in Germany for a time he was subsequently a member of the French Compagnie d'Occident which acquired a grant of territory near New Orleans, La. Du Pratz led an expedition there in 1718 and made unsuccessful attempts to found a colony. In 1720 he went up the Mississippi and settled among the Natchez Indians. Later he explored the region bordering the Mississippi and Arkansas and was for some years treasurer of the land company at New Orleans. He returned to France in 1734. He wrote a valuable and detailed account of his life in Louisiana which was published under the title 'Histoire de la Louisiana' (3 vols., Paris 1758). It was translated into English as 'History of Louisiana' (2 vols., London 1763).

PRAWN, a small decapod crustacean of the family *Palæmonidæ*, allied to the shrimps, in which the beak or «rostrum,» which projects in front of the carapace, is large, toothed and of compresed shape. The common British prawn (*Palæmon serratus*) is three to five inches long, shrimp-like in form, half-transparent and often beautifully tinted, and is taken for market in great quantities by means of nets operated on sandy shores. When boiled, prawns become of a pale pink color, and are highly esteemed as table delicacies in this and in other shapes. Several species occur on the eastern coast of the United States, but are little used.

PRAXEAS, a teacher of the errors of the Antitrinitarians or Monarchians. Data concerning his life are meagre and uncertain. It is claimed that toward the end of the 2d century, after suffering persecution in the reign of Marcus Aurelius for his open confession of the Christian faith, he came to Rome from his native Phrygia to acquaint Pope Victor with the erroneous teachings and vicious practices of the Montanists, and prevailed upon Victor to recall the letters of communion which he had given to those sectaries. But while at Rome and afterward at Carthage he became an apostle of the doctrine of the Monarchians, teaching that in the Godhead is but one Person, who proceeding forth of his own divine essence and called Son, entered the Virgin's womb, was born of her and suffered on the cross; hence the distinctive name of the sectaries who followed Praxeas — Patripassians. See Antitrinitarian; Monarchians; Sabellius; Unitarians.

PRAXITELES, prăks-ĭt'ĕ-lēz, Greek sculptor: b. probably, about 400 B.C. He was an Athenian by birth, the contemporary of Scopas (q.v.), and one of the greatest sculptors of ancient times. The date of his death is unknown; but his life must have been long, since nearly three score works are mentioned as executed by him. He lived in the age of greatest opulence in Greek art, an age succeeding that of Phidias and one which had outgrown the austere vigor displayed in the works of the earlier master. During the time of Praxiteles the life of the individual was less merged in that of the body politic, and became more highly developed. This fact consequent upon the growth of wealth in private possession made the work of the sculptor in demand for the adornment of private houses instead of temples of worship. Praxiteles worked for private buyers, and many of his statues went to Asia Minor as well as Greece. Antiquity placed the highest estimate upon his statue of Aphrodite, and people traveled in large numbers to Cnidus to see it. Lucian records seeing it there about 150 A.D. The statue has disappeared, but an idea of its form may be derived from a Cnidian coin, bearing its effigy, struck in honor of Plautilla. The greatest of his extant works is the statue of the youthful Hermes bearing on his arm the infant Dionysus. This statue, described by Pausanius, was discovered in 1877 by German excavators, at Olympia, where it now remains. The face, which is perfectly preserved, gives to posterity a revelation of the exquisite beauty of the Greek face. The mutilated statue of Demeter from Cnidus, now preserved in the British Museum, is probably by Praxiteles; but the Hermes is the only unquestionable one. Pausanias records that Praxiteles regarded his statue of Eros and one of a satyr as his greatest works. This Eros was presented to Phryne, the courtesan, who posed for the Cnidian Venus, and was afterward placed in the temple at Thespiæ. There was another Eros at Parium on the Hellespont. The Satyr, represented leaning gracefully with his arm on a support, is preserved in reproduction in the Capitoline Museum at Rome, and furnished Hawthorne with his inspiration for his romance, 'The Marble Faun.' The 'Apollo Sauroktonos' (Lizard-Killer), a motive original with Praxiteles, is also known to posterity in reproductions in the Louvre and elsewhere. Reproductions of other works of Praxiteles, the authenticity of which, however, is frequently very doubtful, may be found in many museums and private collections, especially in Athens, Berlin, Dresden, Florence, London, Naples, Paris and Rome. Good casts of his most important works are to be seen in practically every art museum in this country, especially in the New York Metropolitan Museum of Art and in the Boston Museum of Fine Arts. Praxiteles produced in addition to statues portrait busts and genre-scenes, the latter being in the form of sculptured reliefs. His work, which exercised a great influence upon the further development of Greek art, charms by its perfection of grace and its refined and noble expression of human emotions. Consult Kekulé, R. von S., 'Der Kopf des Praxitelischen Hermes' (Stuttgart 1881); Amelung, W., 'Die Basis des Praxiteles aus Mantinea' (München 1895); Furtwaengler, A., 'Masterpieces of Greek Sculpture' (ed. by E. Sellers, London 1895); Klein, W., 'Praxiteles' (Leipzig 1898); 'Praxiteles' (in 'Masters in Art,' Vol. III, Boston 1902); Gardner, E. A., 'Six Greek Sculptors' (London 1906).

PRAY, Isaac Clark, American journalist, dramatist and theatrical manager: b. Boston, Mass., 15 May 1813; d. New York, 28 Nov. 1869. He was educated at Harvard and at Amherst and entered journalism in Boston, where he was at various times editor of the *Pearl*, the *Daily Herald*, the *Sunday Morning News*, the *Dramatic Guardian* and the *Ladies' Companion*. He early engaged in play-writing and in 1836 became manager of the National Theatre where he produced some of his own plays. In 1846-47 he played the leading parts in 'Hamlet,' 'Othello,' and other productions in London, Liverpool and Cork. He went to New York in 1850 as an editorial writer on the *Herald*, and he was afterward a theatrical manager. He wrote about 30 plays and was also author of 'Poems' (1837); 'Book of the Drama' (1851); 'Memoirs of James Gordon Bennett' (1855), etc.

PRAY, James Sturgis, American landscape architect: b. Boston, Mass., 26 Feb. 1871. He was educated at Harvard and in 1903 engaged in independent practice. Since 1906 he has been senior member of the firm Pray, Hubbell and White. He was assistant professor of landscape architecture at Harvard in 1905–14, was appointed chairman of the School of Landscape Architecture there in 1908, and since 1914 he has been Charles Eliot professor. He is author of various articles in the periodicals devoted to his profession and of 'City Planning' (1913).

PRAYER, a religious act taking the form of an entreaty for the grant of favor or the forgiveness of trespasses, and directed toward an object of worship in whose power the answer of this entreaty is supposed to reside. Since prayer is an act almost universal among the religions of the world, it is but natural that it should exhibit a vast range of variation in its form and its spiritual level. The savage may beseech his fetish like a human king, or he may bribe it by offerings and promises, or he may bully it into granting the favors desired. In any case, he is likely to adopt toward it an attitude no more spiritual than that which he adopts toward his fellow savage. His prayer is used for the same purposes as magic, and indeed only differs from magic in that the desired very immediate and very material benefit is accomplished through the mediation of a supernatural person, and not by virtue of the mere wish for the benefit itself. It is rain, or the death of an enemy, or the fertility of his crops, for which he prays, and all notion of the purification from sin is likely to be absent. This awaits the coming of a morality less hand-to-mouth, and the formation of a more or less unified ideal of conduct. While the germs of this inhere in the religion of many races of a low civilization, it is only in such faiths as Buddhism, Judaism and Christianity, which combine a background of vigorous intellectual activity with a fervent exaltation of goodness, that religion habitually expresses itself in "peccavi."

Religion, however, does not run a continually ascending course. The transition from a religion of morality to fetishism, demonology, and magic, easily takes place through the formalism of religious senescence. The faith that has lent dignity to its prayer through a set formula of noble words, or the sonorous cadences of an ancient language, ultimately finds that the formula, the cadences are retained long after all memory of their significance is dead. A condition supervenes — as in many Christian denominations — where the objects of religious worship are held firmly enough in mind, but the prayer, understood but in part by the priesthood and by the laity not at all, has come to be but an induction of the worshipper into a state of devotion. This does not mark the end of the process, which culminates in the mechanical prayer-wheels of the Buddhists of Tibet, who have all but lost their Buddhism in a degraded devil-worship. Here the idea of the object of the prayer has practically vanished, so that religion is about to be resorbed into the magic from which it has emerged with such difficulty.

Even in Christianity, and in cases where the prayer has undergone no significant degree of formalization, the nature of prayer varies between wide limits. It may be like that of the savage, objective in trend, and directed primarily toward an almighty Deity, with the purpose of receiving definite physical benefits. On the other hand, as has been seen among those of a more sensitive religious constitution, prayer is rather an entreaty that the merciful God shall aid a sinner in his avoidance of temptation. This entreaty passes over into a state where full reliance is placed in the goodness and wisdom of God; and entreaty gives way to an inner confession. In these instances the emphasis is not so much on the Deity and the answer expected of him as in the purging of the moral consciousness encompassed by the act of prayer itself. It is this awareness of previous sin and rejection of it, this turning over a new leaf, that lends to prayer its chief value. As William James says, the object of prayer is by far the least important feature of it. The prayer becomes a resolution of good works, accompanied by a faith that this resolution can be realized. The Deity who receives this prayer enters into the prayer merely as a symbol and tangible object serving to fix this faith. (See FAITH). Consult Frazer, J. G., 'The Golden Bough' (London 1911–15); James, W., 'Varieties of Religious Experience' (New York 1902).

PRAYER, Week of, a special period of devotion set apart as a result of a resolution adopted at Manchester, England, in 1846 at a conference of the Evangelical Alliance (q.v.) which urged "members and friends of the Alliance throughout the world to observe the week beginning with the first Lord's day of January in each year as a season for concert in prayer on behalf of the objects contemplated by the Alliance." An appeal from missionaries in India some years later resulted in broadening this scope. The week of prayer has become a settled institution among Evangelical Christians of different churches and countries and has been successful to a considerable extent in promoting Christian union.

PRAYER BEADS, the polished seeds of a West Indian leguminous plant (*Abrus precatorius*) called wild licorice. These seeds were formerly much used for stringing into rosaries, necklaces, etc.

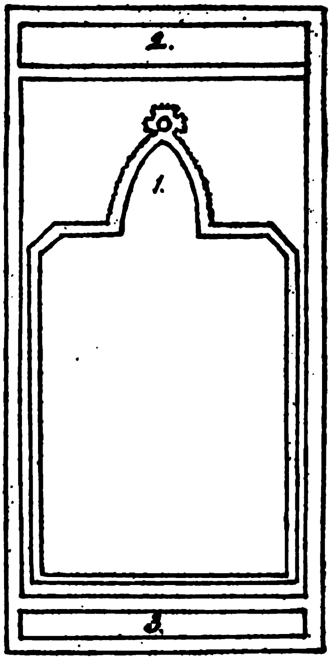
PRAYER BOOK. See BOOK OF COMMON PRAYER.

PRAYER BOOK, Common. See COMMON PRAYER, BOOK OF.

PRAYER FOR THE DEAD. The practice of prayer for the dead prevails in the Roman Catholic, Greek and other Eastern churches. Its purpose is the remission of punishment for sin. The custom seems to have existed in most of the ancient religions, especially in those of India, China and Egypt. The doctrine and practice came to the Christian Church through the Jews (2 Maccabees xii, 44, 45). The first of the Christian fathers who mentions prayer for the dead is Tertullian; but he speaks of the usage as well known and long established in the Church; such prayers are frequently alluded to by Saint John Chrysostom, Cyril of Jerusalem and Saint Augustine. The Roman Catholic practice of prayer for the dead stands of course in a close relation with the doctrine of purgatory, and was discarded with the latter by Protestantism. In the burial service of the first Book of Common Prayer of the English Church some prayers for the dead appeared, but they were deleted from the second book, and are not found in the subsequent revision. Nevertheless, many Anglican clergymen of all periods have approved of such prayers. Consult Boggis, R. J. E., 'Praying for the Dead' (New York 1913); Lucock, H. M., 'Eucharistic Sacrifice and Intercession for Departed' (ib. 1907).

PRAYER RUGS, the Mohammedan rug used for prostration during prayer. In considering anything to do with the Moslem we have to remember that of the many Oriental tribes most of them are nomadic or were so. Hence their customs. Their tent is their home, their furniture consists of rugs. Before the warmth of the fire they sit on the *odjaklik*; their floor is carpeted with the *sedjadeh*; they separate the tent into individual spaces with hangings (*berdelik*). But each devout Moslem (practically the entire population) must have his "prayer" rug (*namazlik*). Being the chief piece of religious furniture his prayer rug is as valuable as his financial condition affords, and on it he prostrates himself five times each day at the prescribed hour. First he spreads his rug in correct orientation, assisted by his compass, seeing that the niche (*mihrab*) points due toward Mecca, the grave place of Mohammed. Next he removes all valuable belongings, such as jewelry, money, etc., from his person to symbolize his abject humility before Allah; he combs his beard as symbol of cleansing, then he brings forth his rosary of 99 beads and a piece of earth or stone taken from Mecca, placing them below the niche. Now he bows his head to the earth, stretches out his arms and in this pose carries out his devotions. The *mihrab* or niche is a point, or projection, extending from the central field of the rug, and represents the niche in which the Koran is preserved in the temple at Mecca. Prayer rugs vary in size from two and one-half to four feet in width by four and one-half to six feet in length. Some are made specially for the owner and have his name in wool on it; these are, of course, of the finest weave. Now and again we come across prayer rugs with a design of three or more niches for combined family or children's worship; mostly they are Caucasian. Some have three small medallions in place of the prayer niche; these spaces are for the knees and forehead of the devout.

Technique.—As each tribe follows closely the traditional designs (*tereh*), handed down through the centuries, more especially in its prayer rugs, they are the more easily assigned to the different localities of origin. The field of the prayer rug is divided into sections as follows: When a single panel (square) only appears it is always above the prayer space; Kulahs have generally but one, also Anatolians; but Bergamos generally have two panels, Ghiordes (see RUGS, ORIENTAL) nearly always, Kulahs seldom. When two panels are in the design one each is placed at the upper and the lower end. We find on some rugs emblems of the equipment crudely defined: a compass, a comb, sometimes the 99 beads of a rosary. A small rhomboidal motif is found on some prayer rugs of Asia Minor designating the place for the devotee to put the earth or stone. Odd motifs figure at the sides of some niches showing where to place the hands in worship. A characteristic of the Ghiordes prayer rug is the shoulder on either side of the base of the niche (see illustration). Pilasters used to support these in the old specimens; some had scroll or floral decoration, but they gradually lost resemblance to pilasters evolving into floral motifs, disappearing altogether in some. Suspended from the niche was a lamp motif or a floral piece, also later disappearing often. Some plant life is usually depicted inside the niche and on the inner side of the border. In the upper panel may be a floral decoration, a scroll or a verse from the Koran. The reclining S (~) or pothook also occurs in panels. A large palmette or rosette partly enclosed by foliage, somewhat like the Herati motif (see RUGS, ORIENTAL) is common in the central border stripe, or square flowers and fruit. The wide stripe is at times represented by several narrow ones decorated with small floral figures. Tekke rugs differ so much from the carpets (*sedjadeh*) they would not be known as of the same tribal make. The glaring reds are not there (in antiques), but are replaced by sober, soft tones of wonderful richness; mahogany color with deep copper bronze tones as relief are usual. The



Outline of the Divisions of a Typical Ghiordes Prayer Rug.
1. Mirhab or Niche.
2, 3. Upper and Lower Panels.

motif in the border is a «multiplied tree pattern» with thin lines of pure white as high lights. The design of the field corresponds with the borders in its tree form motifs. A horizontal band runs midway across the field and a perpendicular traversing it divides the field into four parts, a tree in each. So much does the Tekke *namazlik* differ from others that some of the experts have put them under a different heading, terming them *Hardjli* or Princess Bokhara, and the term of the Armenians is *Khatchli Bokhara* or Cross Bokhara, because of the cross dividing the field. Tekke *namazliks* are wider compared with their length than other prayer rugs with the exception of Ladiks and Bergamos. Prayer rugs owned by Western collectors are rarely Persian as Persian Mohammedans cannot bear the thought of infidel Christians trampling on the sacred field of a *namazlik*, but other Moslems are less strict. Many «prayer rugs» in America were made to order for Western markets.

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PRAYING INDIANS, The, in American colonial history the name given those New England Indians who were early won to the Christian faith. During Philip's War they remained friendly to the colonists, a company of them enlisting under Major Gookin in July 1675. They acted as scouts and spies and rendered valuable service against Philip. Consult Gookin, Daniel, 'An Historical Account of the Doings and Sufferings of the Christian Indians of New England' (in 'Transactions and Collections of the American Antiquarian Society,' Vol. II, p. 423, Cambridge, Mass., 1836); Markham, Richard, 'A Narrative History of King Philip's War' (New York 1883).

PRAYING INSECTS. See MANTIS.

PRE-ADAMITES, those supposed inhabitants of the earth prior to the creation of Adam. The legendary traditions of the East speak of nations and empires existing before Adam's creation, and of a line of kings who ruled over them. In Europe the subject was taken up by Isaac de la Peyrère, who, in a work published in Paris in Latin in 1655, maintained that the Jews were the descendants of Adam, and the Gentiles those of a long anterior creation, founding his opinions on Genesis iv, 14, 17; and Romans v, 12–14. Others maintain that only the white and dusky races descended from Adam, but that the black races existed before him. In modern times the question became again a matter of extensive controversy. Consult 'The Genesis of the Earth and of Man' (ed. by R. S. Poole, London and Edinburgh 1860); M'Causland, D., 'Adam and the Adamite' (London 1872); Winchell, Alexander, 'Preadamites' (Chicago 1880).

PRE-CAMBRIAN FORMATIONS. Those geological formations included in the systems below the Cambrian are sometimes grouped under this name. In America they include the earliest formations, namely, those of the Archean Period (q.v.), and those immediately succeeding them, namely, those belonging to the Algonkian System (q.v.). According to to the earlier, European, nomenclature all the Pre-Cambrian formations fell within the Archean Period, their lower series being called the Laurentian and the higher the Huronian. The latter practically correspond to the Algonkian.

The time occupied by the deposition of the Pre-Cambrian formations extended from the solidifying of the crust of the earth to the beginning of the Cambrian period (q.v.) and as the first traces of life are found in these formations, and as they already show in the variety of their types evidences of long development, the length of time that elapsed during the building up of these formations must have been very great. See GEOLOGY; ARCHEAN; ALGONKIAN; PROTEROZOIC.

PRE-EMPTION LAW, United States. The first pre-emption act was passed 3 March 1801; it was a special act affecting the Symmes colonization scheme on the Miami River. Between that time and 1841 about 18 pre-emption acts were passed, all of a more or less special nature. The first general law was passed in 1830. That of 1841 granted, upon considerations of residence and improvement, freedom of entry upon 160 acres of public lands to any person over 21 years of age, provided he was a citizen or had declared his intention to become one. By act of Congress of 3 March 1891 the various pre-emption laws then in existence were repealed. All bona-fide claims or rights under them, however, were saved. There are now no pre-emption laws on the statutes of the United States. Consult Mallory, John A., comp., 'Compiled Statutes of the United States, Vol. II, pp. 1854–56 (St. Paul 1914).

PRE-EXISTENCE, the doctrine that the soul of an individual had an existence previous to that of the body in which it appears. This opinion was very prevalent in the East, and was held by the Greek philosophers, Pythagoras, Empedocles and Plato himself. A similar doctrine has found some countenance in Christian times among those who were anxious to explain how the soul becomes united to the body, but could not divine any more plausible hypothesis than that all souls were created before the world, and that each has its proper body allotted to it at the time of birth. In opposition to the doctrine of pre-existentism is that of traducianism, which teaches that the soul, like the body, is propagated; and creationism, in accordance with which a new soul is immediately created out of nothing by God for each newly propagated body. Consult Müller, Julius, 'The Christian Doctrine of Sin' (Edinburgh 1852–53); Howison, G. H., 'Limits of Evolution' (New York 1901).

PRE-RAPHAELITES, members of the «Pre-Raphaelite Brotherhood» and their followers. The original brotherhood was founded by the association of three painters, Dante Gabriel Rossetti, William Holman Hunt and John Everett Millais. The inspiration, however, which gave life to the Pre-Raphaelites was derived from an artist who never joined the brotherhood, Ford Maddox Brown. In 1848 Rossetti became the pupil of Ford Maddox Brown, a great and original artist whose work was quite neglected at a period when Victorian art in England had sunk to its lowest condition of commonplace prettiness, conventionality and utter want of mysticism or spirituality. Ford Maddox Brown, the practical originator of the new school of English painting, and the bringer-in of a new English Renaissance, had attracted the notice of Rossetti by his powerful picture, 'Parisina's Sleep,' which was exhibited at the British Institution 1845 and was conspicuous for marvelous atmosphere, finish and fidelity of expression. Rossetti became the devoted disciple of this master. Rossetti was a poet, full of dreams and desires, and passionately striving after the true and the beautiful. At the academy schools he met William Holman Hunt, a man of profound religious feeling, yet reserved, hard working and bound on notable and original achievement in art. With them was eventually associated John Everett Millais, already a brilliant and successful artist, and far in advance of his confrères of equal age in all the skill that comes from knowledge and practice. These men, strangely different in artistic temperament, formed a powerful trio devoted to making a fearless protest against the shallow and insincere banalities of the day. They called themselves Pre-Raphaelites; but, as W. Holman Hunt has said, "Neither then nor afterward did they affirm there was not much healthy and good art after the time of Raphael; but it appeared to them that afterward art was so frequently tainted with the canker of corruption that it was only in the earlier work they could find with certainty absolute health. Up to a certain point the tree was healthy: above it, disease began; side by side with life, there was death." Their artistic doctrines were indeed to be summed up in the one word *sincerity;* the bond of union between them, as enunciated by one of their number, was (1) to have clear ideas to express; (2) to study Nature attentively, so as to know how to express them; (3) to sympathize with what is direct and serious and heartfelt in previous art, to the exclusion of what is conventional and self-parading and learned by rote; and (4) most indispensable of all, to produce thoroughly good pictures and statues.

The three founders of the association which Ford Maddox Brown had inspired were subsequently joined by Thomas Woolner, sculptor; James Collinson, painter, who eventually left the brotherhood; Walter Howell Deverell, painter; Frederick George Stephens, painter and art critic; and William Michael Rossetti, younger brother of Dante Rossetti, and like the latter, a poet. Ford Maddox Brown declined to join simply because he disliked coteries, and it certainly was not he who gave the doctrine its name of Pre-Raphaelitism. But, as his own work was an embodiment of this artistic creed, so his association with the members of it was always close and his sympathy with their work enthusiastic. Millais remained in the brotherhood 10 years (1849–59); he then dropped out, became a fashionable portrait painter and famous for his power in painting children, and such textures as satin and velvet. W. Holman Hunt kept on an uncompromising adherent to the principles of the brotherhood. But before the work the Pre-Raphaelites had to do was accomplished, they were compelled to run the gauntlet of criticism and ridicule from those whose system and method of painting they were attacking. In the *Times* of 5 May 1854 a letter appeared signed by John Ruskin, boldly praising and defending the new school. It is doubtful, however, whether Ruskin understood the principle of Pre-Raphaelitism, and it is a mistake to think that his writings gave the first suggestion for the formation of such a league.

Pre-Raphaelitism has become a permanent influence in English art. The generation of English artists which succeeded that in which Ford Maddox Brown lived has followed the guidance of the Pre-Raphaelites, either as to romantic motif, mystic religiousness or drawing and technique; sometimes in all of these. In certain quarters, however, there appeared a tendency in a somewhat perverted manner to carry out the traditions of the brotherhood, by an exaggerated mediævalism, a deliberate crudeness or grotesqueness of design and an insistence on minute detail. The most important English artists who were influenced by Pre-Raphaelitism were: William Morris, W. S. Burton, M. J. Lawless, Robert Martineau, Walter Crane, Sir Edward Burne-Jones and E. De Morgan.

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PREACHERS, Orders of. See DOMINICANS.

PREACHING FRIARS. See DOMINICANS.

PRÉAULT, prā-ō, **Antoine-Auguste,** French sculptor: b. Paris, 8 Oct. 1809; d. there, 11 Jan. 1879. He began his art studies with a decided tendency toward romanticism and entered the studio of David d'Angers, but soon left it and ever afterward aimed at a naturalistic treatment of art themes. This was proved by the first works he exhibited at the Salon (1833) — 'Misery,' a group representing a girl dying in the arms of her mother; and two reliefs, 'Death of the Poet Gilbert in Hospital' and 'Famine.' In the following years he exhibited numerous works, among them the statue 'Undine'; and the relief 'River Amazon'; 'Queen of Sheba'; a sitting figure of Hecuba; the colossal statue 'Charlemagne'; and the statue 'Carthage.' None of these works were admitted to the Salon, but in 1849 the opinion of his merits had changed and the doors of the exhibition in the Champs Elysées were opened to him. After this he was represented there by his ‘Christ on the Cross’ (now in the church of Saint Gervais); the relief ‘Ophelia’; the statue of ‘General Marceau’ at Chartres; the statuette ‘French Comedy’; and many other works, amongst which there were many sepulchral monuments. The most famous of these, perhaps, is ‘Silence’; now in the Père-Lachaise cemetery. As a sculptor his workmanship was fine, but he sometimes failed to control his fancy and strong feeling for realistic form within that reserve and restraint prescribed by the canons of strictly plastic art. He was a tireless worker and one of the most ardent and powerful representatives of the new realistic school of sculpture. Consult Chesneau, E., ‘Auguste Préault’ (in ‘L’Art,’ Vol. XVII, p. 3, Paris 1879); Chesneau, E., ‘Pedutres et statuaires romantiques’ (Paris 1880).

PREBEND, a stipend paid to an ecclesiastic from the foundation funds of a cathedral or collegiate church. Prebendary is the person who holds a prebend. A simple prebend has no more than the revenue which is assigned for its support; but if the prebend has a jurisdiction annexed, the prebendary is styled a dignitary. Prebendaries, as such, have no cure of souls; but a prebendary may, and frequently does, hold a parochial benefice as well. The prebendal stall is the seat of the prebendary in the church, into which he is inducted by the dean and chapter.

PREBLE, prĕb'l, **Edward,** American naval officer: b. Portland, Maine, 15 Aug. 1761; d. there, 25 Aug. 1807. When about 16 he ran away from home and joined a merchantman, on which he went to Europe; on his return in 1779 he entered with his father's approval the Massachusetts State marine as midshipman on the *Protector* and participated in the attack on the British ship *Admiral Duff* which was destroyed. In 1780 he was captured on board the *Protector* and imprisoned on the prison-ship *Jersey* in New York Harbor. Upon his release he served on the *Winthrop,* another Massachusetts State ship, and with 14 men boarded an armed British brig and took her out of Penobscot Harbor in the face of the enemy's battery. At the conclusion of peace the Massachusetts navy was disbanded in 1782. For the next 16 years he devoted himself to commercial pursuits and made a number of journeys to various parts of the world. On the organization of the United States navy in 1798 he was one of the first five to be commissioned lieutenant, and in 1799 was promoted captain in command of the *Essex* with which he convoyed a fleet of 14 valuably laden merchantmen from China. In 1803 he was assigned to the *Constitution* and given command of the squadron against the Barbary powers. He arrived at Tangiers in October 1803 and speedily forced from the Sultan of Morocco a renewal of the treaty of 1786. The *Philadelphia* of his squadron was captured while pursuing Tripolitan gunboats and Preble blockaded Tripoli for several months endeavoring to regain or destroy the ship. In July 1804 he bombarded Tripoli and subsequently conducted six vigorous attacks in which he captured three gunboats and sunk three others. In September the relief squadron under Preble's senior officer, Captain Barron, arrived and Preble returned to the United States early in 1805. The treaty was signed in 1805 without further fighting and Preble received a gold medal and the thanks of Congress. After his return his health showed signs of serious impairment. And, without again assuming active duty, he died after much suffering in his 47th year from consumption. Consult ‘Naval Operations against Tripoli’ (in ‘American State Papers,’ Class VI, Naval Affairs, Vol. I, 1794–1825, p. 133, Washington 1834); Waldo, S. P., ‘Biographical Sketches of American Naval Heroes in the War of Revolution’ (Hartford 1823); Sparks, Jared, ed., ‘The Library of American Biography’ (Series II, Vol. XII, Boston 1847); Preble, Q. H., ‘First Three Generations of Prebles in America’ (Boston 1868).

PREBLE, George Henry, American naval officer: nephew of Edward Preble (q.v.), b. Portland, Maine, 25 Feb. 1816; d. Brookline, Mass., 1 March 1885. He entered the navy as midshipman in 1835, served in the Mediterranean on the frigate *United States* in 1836–38, on various boats of the West Indian and Gulf squadron in 1839–40, was engaged in the war against the Seminoles in 1841–42, and in 1843–45 circumnavigated the world on the *Saint Louis,* attaining the distinction of landing the first American force in China. In the Mexican War he participated in the battles of Alvaredo, Vera Cruz, Laguna, Tampico, Panuco and San Juan de Ulloa; in 1848 he was commissioned a lieutenant; from 1853–56 he was in Japan and China with the Perry expedition and in 1854–55 he was engaged in several actions with Chinese pirates. In 1862 he commanded the steam gun-boat *Katahdin* under Farragut at the capture of New Orleans, was commissioned a commander in that year and for failure to capture the Confederate cruiser *Oreto* was dismissed from the navy. Investigation proved him blameless, however, and in 1863 he was restored to his rank, placed in command of the *Saint Louis* with which he engaged in pursuing Confederate rovers in foreign waters. In the latter part of 1864 he blockaded the North Edisto River, and a little later was placed in command of the fleet brigade organized by Admiral Dahlgren at Port Royal for the purpose of co-operating with General Sherman. Under his command the brigade engaged on 30 Nov. 1864, in the successful battle of Honey Hill. In April 1865 he was put in command of the steamer *State of Georgia.* From October 1865 to July 1867 he was inspector general of supplies at the Charlestown navy yard. From August to December 1867 he acted as chief of staff of the North Pacific squadron, commanding the flagship *Pensacola* and in March 1867 was commissioned a captain. He was commissioned commodore in 1871, and in 1873–75 had charge of the navy yard at Philadelphia. In 1876 he received rank as rear-admiral, was in command of the South Pacific station in 1877–78 and in 1878 was retired. He wrote ‘Chase of the Rebel Steamer of War Oreto’ (Cambridge, Mass., 1862); ‘Genealogical Sketch of the First Three Generations of Prebles in America’ (Boston 1868); ‘Our Flag. Origin and Progress of the Flag of the United States of America, etc.’ (Albany 1872); ‘History of the Flag of the United States of America, and of the Naval and Yacht-Club Signals, Seals and Arms, etc.' (1880); 'A Chronological History of the Origin and Development of Steam Navigation' (Philadelphia 1883).

PRECEDENCE, in official life, the order in which men and women follow each other according to rank and dignity in a State procession or on other public occasions. In England the order of precedence depends partly on statutes and partly on ancient usage and established custom. Questions arising on matters of precedence depending on usage are hardly considered as definitely settled and are in a great measure left to the discretion of the officers of arms. The sovereign, of course, is always first in order of precedence, after whom in descending order follow the Prince of Wales, younger sons of the sovereign, grandsons of the sovereign, brothers of the sovereign, uncles of the sovereign, nephews of the sovereign, ambassadors, the Archbishop of Canterbury, the Lord High Chancellor, the Archbishop of York, the Prime Minister, and so on through the high state dignitaries, the various ranks of the peerage, etc. The order of precedence among women follows the same rules as that among men, except that wives and daughters of men possessing official precedence do not participate therein and are ranked entirely by whatever personal standing they may possess by virtue of inherited titles or dignities. By the acts of Union of Scotland and Ireland the precedence in any given degree of the peerage has been established as follows: (1) Peers of England; (2) Peers of Scotland; (3) Peers of Great Britain; (4) Peers of Ireland; (5) Peers of the United Kingdom and Peers of Ireland created subsequent to the Union. The question of precedence in recent times has lost much of its former importance as a result of the spread of democratic institutions. England is, perhaps, still more interested to-day than any other country and has more extensive and detailed regulations concerning it, though, of course, rules governing precedence are in existence in practically every civilized country in the world.

In the United States the most generally accepted order in Washington official life is as follows:

The President,
The Vice-President,
President of the Senate,
Foreign Ambassadors,
Chief Justice of the Supreme Court,
United States Senators,
Speaker of the House,
Representatives in Congress,
Associate Justices of the Supreme Court,
Secretary of State,
Diplomatic Corps (other than ambassadors),
Secretary of the Treasury,
Secretary of War,
The Attorney-General,
The Postmaster-General,
Secretary of the Navy,
Secretary of the Interior,
Secretary of Agriculture,
Secretary of Commerce and Labor,
General Staff of the Army,
Admirals of the Navy,
Governors of States.

Then follow the judiciary, diplomatic representatives of the United States, army and navy officers, chiefs of departments, foreign consuls, secretaries of legations, etc.

Questions of international precedence arising as a result of international commissions or of the signing of treaties by several countries, are solved usually by arranging the names of the countries in alphabetical order. The precedence of diplomatic representatives is determined by the date of the presentation of their credentials, except that ambassadors outrank envoys and ministers plenipotentiary. Consult Burke, 'Peerage'; MacKenzie, Sir George, 'Observation Upon the Laws and Customs of Nations as to Precedency' (Edinburgh 1680); Hellbach, J. C. von, 'Handbuch des Rangrechts' (Ansbach 1804).

PRECENTOR (Latin, *præ*, before; *canere*, to sing), a leader of singing. In cathedrals of ancient foundation of the Established Church of England the precentor is a member of the chapter and in dignity ranks next after the dean; in cathedrals of the new foundation, that is, those of sees created by Henry VIII or formed in later times, the precentor is only a minor canon and is removable at the pleasure of the dean and chapter. During solemn functions the precentor's place is on the north side of the chancel, while that of the dean is on the south side. In the Presbyterian churches of Scotland it was formerly the custom that half an hour before the arrival of the minister, the precentor would read to the congregation lessons from the Scripture; when the minister entered, the precentor would give out a psalm and lead the singing; hence his desk, below the pulpit, is still called lectern, or in Scotch dialect *lettran*, that is, reading-desk. In the rural districts of Scotland it is still customary for the precentor to read each verse of a psalm before it is sung.

PRECEPTORS, College of, London, England, a training school for teachers founded in 1846 and granted a Royal Charter in 1849 "for the purpose of promoting sound learning and of advancing the interests of education, especially among the middle classes, by affording facilities to the teacher for acquiring a knowledge of his profession." The college established examinations for teachers and for students in the secondary schools, issuing diplomas and certificates; and performed pioneer work in the training of teachers for the secondary schools. The school examinations, established in 1853, served as standards by which teachers could guide their work. The first examination in the theory and practice of education was held in 1867 and in 1873 the first professorship in education in England was established by the college. There are practical examinations for certificates of ability to teach as well as the written theoretical examinations; and there are, as well, winter meetings and short courses for teachers. The examinations conducted for pupils in secondary schools have proved of value as the marks obtained are recognized by the board of education and by many professional associations. The college has power to inspect schools and decide upon their suitable housing and equipment, as well as upon the adequacy of the teaching staff and the general organization. Membership in the college is open to persons over 18 years of age who have passed the examination prescribed by the council and been thereafter elected. The college is located in Bloomsbury Square and has a library of 10,000 volumes. The organ of the college is the *Educational Times*, published monthly and one of the oldest educational journals in

England. Consult ‘Annual Calendar, College of Preceptors’; Board of Education of England's ‘Report of the Consultative Committee on Examinations in Secondary Schools’ (1911); ‘Schoolmaster's Year Book’ (London, annual).

PRECESSION OF THE EQUINOX. See Equinox.

PRÉCIEUSES RIDICULES, Les, lā prā-sē-ė rē-dē-kül, a comedy by Molière (q.v.), produced for the first time 18 Nov. 1659. No one of Molière's comedies is better known than this famous satire on the «Précieuses,» which can almost be entitled a farce, being an exaggeration of an exaggeration. It is in one act and is a satire on a style of speech and an affected taste in art and literature, prevalent among a certain class at that time. When writing it Molière had in mind the literary lights who assembled at the Hôtel de Rambouillet, the residence of the Marquise de Rambouillet (q.v.). Consult Lang, Andrew, ed., ‘Les Précieuses Ridicules’ (Oxford 1890); Davis, W. M., ed., ‘Les Précieuses Ridicules’ (Boston 1895).

PRECIOUS METALS. Gold and silver are commonly included under this term, though platinum and quicksilver have sometimes been added. However, on the basis of their having sufficient value and being abundant enough for coinage, gold and silver are more accurately described as precious metals. America has contributed largely to the total amount of the precious metals in circulation in the world. The United States, Mexico and Australasia are the three countries which rank highest in annual total production of these metals according to their monetary value.

Fine ounce of gold, $20.671834 +; fine ounce of silver, $1.292929 +, coining rate in United States silver dollars.

The United States, therefore, while greatly surpassed in the amount of gold produced by Africa, and in silver by Mexico, far surpasses every other country in the total value of precious metals produced. It is estimated that the total production of gold in all countries since the discovery of America amounted to 825,000,000 fine ounces in 1919, while the total production of silver in the same period was 12,000,000,000 fine ounces. See Commerce, *History of*; Gold; Mineral Production in the United States; Platinum; Silver; and consult Smith, E. A., ‘Sampling and Assay of the Precious Metals’ (Philadelphia 1914).

PRECIOUS STAR, Order of. See Orders, Royal.

PRECIOUS STONES. A substance to be precious must possess variety, beauty, durability and portability. Precious stones, phenomenal stones and semi-precious stones are such as may be used for ornamental jewelry. Strictly speaking the term precious stone is reserved to designate the diamond, the ruby, the sapphire and the emerald, the others being called «phenomenal» and «semi-precious,» but the designation «precious» has been loosely used to indicate all stones used for the jeweling of choice objects of adornment. The following are those which chiefly claim attention:

Diamond.— See the special article describing this gem.

Spodumene has a hardness of 6.5 — 7, and a specific gravity of 3.13 — 3.19. The rich green variety, ***hiddenite***, named after the late William Earle Hidden, was found at Stony Point (now named Hiddenite), Alexander County, N. C., in crystals furnishing gems weighing up to five carats each. A yellow variety which occurs in Brazil is called triphane. *Kunzite* (q.v.) is a rich, lilac-hued variety of spodumene, of which fine examples come from Pala, San Diego County, Cal., It also occurs in crystals weighing up to 100 carats in Madagascar. Spodumene was at an earlier time called «triphane,» a name given it by the great crystallographer Haüy.

Titanite (or sphene) is a calcium silicotitanite, having a hardness of 5.5 and a specific gravity of 3.5. It furnishes the most brilliant yellow and brown gem except the diamond. Fine examples have been found in Bridgewater, Bucks County, Pa., from which gems weighing from 10 to 20 carats could be cut. Other sources are the Tilly Foster Mine, New York, and the Pfitschtal and Zillertal, in Tyrol.

Tiffanyite.— A name given to a hydrocarbon assumed to be present in certain diamonds, namely those which on that account exhibit fluorescence and phosphorescence. The substance apparently has a bluish-white color. The blue white diamonds of Brazil are called Tiffanyite diamonds.*

Moissanite.— A natural carborundum, a carbon silicide, of which the French chemist, Henri Moissan, found, in 1905, small blue or bluish-green crystals in the meteorite of Cañon Diablo, Arizona, in association with microscopic diamonds. It belongs to the rhombohedral division of the hexagonal system. The cleavage is poor; the fracture conchoidal; the hardness is next to that of the diamond. The refractive indices are higher than 1.75. As many as 44 varieties of the crystal forms have been observed. The name was given in honor of the discoverer.†

Rubies and Sapphires.— The ruby and the sapphire are transparent varieties of corundum (q.v.), the first being carmine-red, and the second bright blue and velvet blue. Other colors also occur, as yellow, green and purple, called, respectively, Oriental topaz, Oriental emerald and Oriental amethyst. Corundum crystallizes in the hexagonal system, and consists of alumina nearly pure. In hardness it ranks next below the diamond, being rated as nine on the scale. The finest rubies are found in Burma, in the Mogok Valley, northeast of Mandelay. They are also mined in Siam, where they are of a darker shade, and in Ceylon, where they are of lighter hue and often of great brilliancy. The finest Burmese rubies have a peculiar tint, called «pigeon's blood.» Rubies of large size are extremely rare, and when they weigh four carats or more they are worth from two to five, and formerly 10 times the price of diamonds of the same size. Sapphires come principally from Ceylon, Cashmere and Siam, the finest tints being known as the «cornflower» and the «velvet blue.» In Australia, especially at Anakie in Queensland, many dark-blue sapphires are found, too deep in hue to be of value if cut into large gems, so they are generally cut as calibre or small stones. Queensland has furnished some wonderful golden-yellow corundums, these being the centres of blue crystals. Sapphires are also found in Montana at several points, generally under two carats each; the choicest are mined at Yogo Gulch, in Fergus County. These are of a rich blue color. Other mines are at Rock Creek, Granite County, where there is a great variety of shades; examples also occur at Cottonwood Creek, and along the bars of the Missouri River, not far from Helena, Mont. Fancy colors are of little value compared to the blue.

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* Appendix I, Dana ‘System of Mineralogy,’ p. 68, 1899; citing George F. Kunz, N. Y. Acad. Sciences, Vol. XIV, p. 260; 1895.

† Second Appendix to the 6th ed. of Dana's ‘System of Mineralogy,’ New York 1909, p. 70.

Beryl, Emerald and Aquamarine are the same mineral, a silicate of aluminum and glucinum. The hardness is eight and the crystals belong to the hexagonal system. Beryl varies from blue through light green to yellow, when it is called "golden beryl," and forms a gem resembling topaz. If colored a rich green by a little oxide of chromium, it becomes the emerald, a stone which is rarely flawless, but ranks in value with the diamond. The chief source of fine emeralds has long been the mines at Muzo, about 70 miles on a direct line from Bogotá, Colombia, where they occur in a black limestone rock. The mine has been worked by Europeans for three centuries, and was previously exploited by the native peoples of the region. The emeralds known to the ancients came principally from Upper Egypt, near the Red Sea. These mines were long abandoned and left unworked, but are now being operated on a small scale. Light sky-blue, rich ocean-blue, sea green or greenish beryls are known as aquamarines; the finest examples have come from Brazil and Madagascar. A Brazilian crystal weighed 246 pounds. They also occur in the Urals and Siberia, as well as in Maine, North Carolina and Colorado. Golden beryls are found in Maine, Connecticut and Pennsylvania. A variety of golden beryl found at Rössing in the former German Southwest Africa has been given the trade name "heliodor."

Phenomenal Gems.— The name applied to precious stones which change in color or else have a change of light or exhibit some phenomena other than the color itself. Notable among these are the sapphire asteria and ruby asteria; the ruby asteria or star ruby is found in Ceylon and in the ruby mines of Burma, and is a phenomenal gem in high favor. Then come the alexandrite, a variety of chrysoberyl changing from a dark green by daylight to a columbine red by artificial light; the chrysoberyl cat's-eye, changing from pale honey yellow to dark brown, and, occasionally, the alexandrite cat's-eye, green by day and red by artificial light; moonstone, a white feldspar exhibiting the phenomena of lustre, and a white or bluish play of light; sunstone, in which there are brilliant reflections from the interior of the feldspar or quartz; labrador spar, labradonite feldspar, which has a rich play of blue, blue-green and yellow, resembling a peacock feather. All of these are surmised to bring good fortune to the wearer.

Chrysoberyl, which has a hardness of 8.5, is a glucinum aluminate. It is a rare mineral, of various shades of yellow, brown, light green and dark green. One variety contains minute impurities distributed between the layers of the crystal, and these layers are so arranged, by what is termed the "twinning" of the crystal, that when the stone is cut across them light is reflected or condensed into a transverse bright line; such a gem is called a chrysoberyl cat's-eye.

Alexandrite is a variety of chrysoberyl, colored by chromium. This name was given by Nordenskjöld because the gem had been found on the day the Czarevitch, later Alexander II, came of age, in 1833. It was first discovered in the Ural Mountains at Takowaya, but now occurs in larger gems, up to 70 carats each, in the gem-gravels of Ceylon. It possesses the property of changing from a dark green to a columbine red when exposed to artificial light, thus displaying in turn what were the Russian national colors at the time it was first discovered.

Morganite is a rose red silicate of beryllium containing manganese, found in Madagascar, being the same in composition as the aquamarine and the emerald, differing only in color. It possesses the property of becoming phosphorescent as does kunzite, a mineral with which it is associated. It appears in beautiful gems up to 200 carats each. It occurs, also, at Pala, in San Diego County, Cal., in crystals of some size, and example, small and not of good color, are met with at Haddam, Conn., but not in gem form. The name was given in honor of the late J. Pierpont Morgan.

Zircon, or **Hyacinth** (jacinth), sometimes called jargon, is a gem of 7.5 in hardness and having a specific gravity of 4.1 to 4.7, occurring brown, yellow, blue, green and white; it is a zirconium silicate. Frequently the white gem is the result of the decolorization of a darker stone. These were frequently rose-cut in the East, and in the 18th century were called "Matura Diamonds." The color sometimes returns after decolorization. The chief source of supply has been Ceylon, although many fine gems have been found in Australia and Tasmania.

Topaz is a rather complex silicate of aluminum, occurring in rhombic prisms and possessing a hardness of eight. It is generally yellow, but other examples are pale blue, pale green, pale brown and white or colorless. The favorite tint is a peculiar yellow known as sherry color. The finest come from Brazil or from the Ural Mountains, but some very handsome ones have been found in Colorado and Utah. The sherry-colored variety, if heated in vacuo, changes to a rich, almost magenta pink, then to a light pink and finally becomes colorless. White topaz is often found in large masses in Ceylon, and in Brazil, where a 23-pound mass was found. Fine blue and cinnamon colored crystals occur in the Urals, in Siberia, Japan, Mongolia and in Colorado, Texas and Maine; the cinnamon-colored variety changes, upon exposure to daylight, to colorless topaz. (See also QUARTZ; nearly all the so-called topazes are really citrines — decolorized smoky quartz).

Tourmaline is a complex silicate of aluminum, occurring in prisms of six, nine or 12 sides. It is usually black, but also of transparent red, green and other colors, often singularly mingled in the same crystal. The gem is found in Brazil and Siberia, and examples of great beauty are met with at Paris and

Auburn, Me., Haddam Neck, Conn., and especially in San Diego County, Cal. Mineralogically it occurs in a great variety of colors and forms; the red is known as rubellite, the blue as indicolite, the white as achroite and the green is called «Brazilian emerald» in Brazil. Wonderful red tourmalines rubellite are found in the Ural Mountains, Russia, and red and other colors in Madagascar. At times the crystal is green on the exterior with a white zone and a red interior, the iron which causes the green hue being neutralized by the manganese in the red color; this strange combination forms the so-called «watermelon crystal.» Tourmaline is probably the most varied interesting mineral, with the exception of quartz, occurring in magnificent gems of green, blue, red, yellow, brown, white and frequently three or more colors are present in distinct zones in various parts of the crystal. Its electric properties, discovered in the 18th century, was discussed in most of the European learned societies at that time, the name «Aschentrekker» («Ash-attractor») being given to the mineral in Amsterdam.

Garnet is the name of a group of minerals closely related in form and properties, but presenting a number of varieties. They are all very complex aluminum silicates, in which various metallic oxides enter as components. The principal gem varieties are almandine, or precious garnet, the carbuncle of the ancients, containing considerable oxide of iron; its color is a deep, rather purplish or brownish red; pyrope, or Bohemian garnet, containing much magnesia, of a fine dark crimson, almost a ruby color. These two are the red garnets of jewelry; when cut *en cabochon*, that is, not facetted, but dome-shaped, they are called carbuncles. Manganese garnet, or spessartite, is sometimes of a very beautiful orange-brown color; elegant gems of this kind have been found at Amelia Court House, Va. Uvorovite, or chrome garnet, is a rare variety, of a brilliant dark green color, but the crystals are very small. Another green garnet of somewhat different composition, and with very brilliant lustre, from the Ural Mountains, is called demantoid, or Uralian emerald. Much fine garnet is found in the United States. North Carolina yields a beautiful variety that has been called rhodolite,— a brilliant light red garnet, between almandite and pyrope in composition; these are largely mined in the Cowee Valley, in Macon County. New Mexico and Arizona produce fine pyropes, often misnamed «Arizona rubies,» and equalling those of any other known locality. They are found where ants and centipedes have carried them out in making the galleries of their hills. In South Africa similar pyrope garnets found with the diamonds are termed «Cape rubies.»

Quartz is pure silica, the crystalline, rock crystal type occurring as six-sided crystals. It embraces a great number of the commoner gem stones, specific gravity about 2.6. These fall into three distinct groups,— The transparent colorless variety, rock crystal, then the purple amethyst which is colored by manganese, and finally the smoky topaz or smoky crystal, the ordinary black variety, and the intensely black «morion.» When the black variety can be decolorized by heat, it changes first to a deep brown and then to a transparent yellow, sometimes becoming almost colorless. The original smoky quartz, deep brown in color, is called «cairngorm»; it is mostly used in Scotland and is the Scotch national stone. The lighter colors produced by decolorization by heat are known as Spanish topaz and citrine. Nearly all the so-called topaz of commerce is a quartz variety, not true topaz.

The cryptocrystalline variety, agate, is usually banded, and is generally the result of deposition of silica in the amygdules of a volcanic rock. The structure is in thin layers, even though they may not be visible to the eye. The principal varieties are chalcedony, gray and blue-gray, the apparently unbanded variety; when banded it is called «banded agate.» When this banded material has been broken and recemented, it bears the name of «ruin agate»; if the bands are irregular in outline it is denominated «fortification agate.» Chalcedony, when treated with iron salts and then highly heated, becomes red and is known as «carnelian»; if there be one or more layers, one of which is compact and impervious, it forms the «onyx» (from Greek word signifying «nail»). Should any one of two layers be pink, reddish or brown, it is termed «sardonyx.» The latter name has been applied to an artificially colored variety, from pale brown and pale red to brown; when black with a thin white, copper-colored layer, it appears gray, and is called «nicolo.» The name onyx is also applied to chalcedony saturated with boiling honey or blood, and then treated with sulphuric acid, the blood or honey becoming carbonized and making the entire stone a deep black. When chalcedony is stained a translucent red or brown it is also called sardonyx, although it is really not an onyx, as it has only one layer.

The uncrystalline, or slightly crystalline, varieties are notably red jasper and green jasper. When jasper is green with red spots, due to the oxidation of the iron in the stone, it is called «bloodstone.» When the stone is yellow, brown or black, the term jasper is also used.

Opal is silica containing from 5 per cent to 10 per cent of water. When it contains more than 5 per cent of water, the opal is liable to fracture; with 5 per cent or less, it is a stone of considerable durability. Magnificent specimens of the white variety have been found in the mines of Hungary and in New South Wales, the white opals in New South Wales occurring in sandstone in which they occasionally replace wood, shells and the bones of reptiles. The black variety offers a velvet black field broken with the most intense red, green, yellow, blue and other colors. This is greatly prized and highly valued; it is found in the Lightning Ridge region in New South Wales. Many thousand fine gems have been brought from this locality, single stones selling for $5,000. The fire opals are a rich, red, honey or honey-red variety, containing a high percentage of water. The fire opal, or flame opal, found in Queretaro and other parts of Mexico is a rich honey-red —a brilliant variety with prominently large flames of light color, possibly due to inclusion of rutile (oxide of titanium). A colorless variety is also found, in which the play of color is in small flecks. This is known as the harlequin opal. Interesting opals replacing wood have been found in Humboldt County, Nev., brown, black and colorless.

Peridot, Chrysolite, or **Olivine,** deriving its name from its olive-green color, is a silicate of magnesia, found in magnificent examples in Egypt. Many magnificent specimens brought from the East are found in the church treasuries, dating from the time of the Crusades, notably at Cologne. They were then called emeralds. After a close study of the peridots here and in other ecclesiastical jewels, the opinion is expressed that almost if not quite all the fine examples in modern jewelry had been derived from this source. In 1900, gem chrysolites were found on the small volcanic island Seberget (also called Zebirget or Saint John) near the Egyptian coast of the Red Sea, an interesting discovery as it serves to confirm the ancient tale in early Greek and Latin authors that their chrysolite (which they called topaz) came from a mysterious «Serpent Isle» in the Red Sea. They are also found in the Navajo Reservation in New Mexico, in small gems of considerable beauty; in Hawaii, as honey yellow and small gems; and at Lac La Hache, British Columbia.

Jade.— This name is commonly used to designate both *nephrite* (a silicate of magnesium and calcium), and *jadeite,* named by Damour in 1863 (a silicate of aluminum and sodium). Nephrite has a hardness of 6.5, its specific gravity being 2.8, while jadeite's hardness is 7 and its specific gravity 3.3. The Chinese name for jade is *yu,* or *yu-shi;* the most prized variety of jadeite is termed *fei-tsui,* «kingfisher-plumes,» jewel jade or imperial jade. The jade brought by the Spaniards from the New World was named by them *piedra de ijada,* «stone of the flank,» whence our «jade»; it was asserted (and believed) to be a highly efficient remedy for diseases of the kidneys. This belief was reflected in the later name *lapis nephriticus* (kidney-stone) from the Greek *nephros,* «kidney,» the origin of our nephrite. A third stone of the jade group is *chloromelanite,* discovered by Damour in 1865. This mineral, with a hardness of over 6.5 to 7 and a specific gravity of 3.4, is of a darker green than jadeite (with which it is very closely related) because in its composition iron supplants a part of the alumina in the latter. A number of prehistoric ornamental objects of *chloromelanite* have been found in France, and a few in the lake-dwellings of Switzerland, as well as in Mexico, Guatemala and Colombia. The chief source of supply for nephrite has been in modern times the Kuen-lun Mountain in eastern Turkestan, while the jadeite now mined comes from the Kachin Hills, about 120 miles from Mogaung, Upper Burma. The nephrite of New Zealand, called by the natives *punamu,* or «green-stone,» is also well known. Numerous jade artefacts made in prehistoric times have come to light in almost all parts of the world, although the source whence the stone was obtained has not often been determined. For a time it was rather generally believed that none of it could be found *in situ* in Europe, and that the material for the European artefacts and for those discovered in the Americas as well was strictly of Asiatic origin. This erroneous idea has been entirely dissipated by several discoveries of nephrite in its original place at various European localities. The largest mass ever extracted was found by the present writer in 1899 at Jordansmühl, Silesia; it weighed 4,718 pounds (2,140 kilograms). This is in the Heber R. Bishop Collection in the American Museum of Natural History, New York City.

The fondness of the Chinese for jade is proverbial, and the finest ornamental objects (both of nephrite and of jadeite) have been produced by Chinese lapidaries, although to Hindu and other Asiatic artists also may be credited admirable work, and in New Zealand, as well, the native nephrite has been quite skilfully carved, as in the case of the curious *hei-tikis,* grotesque ancestral heirlooms with which some superstitious fancies are associated. In hue, jade runs through the gamut of the different shades of green, from the darkest to the lightest; some specimens are quite white. Jadeite is occasionally almost transparent, of a rich emerald green Jewel jade or Imperial jade, when containing a greater quantity of iron or chromium with a specific gravity up to 3.6 is called chloromelanite.

The color, translucency, hardness, toughness and fine structure are the properties that have rendered jade a very attractive material for the most artistic lapidaries of China, India, ancient Mexico, France, Russia and other countries. The Chinese have been the most pre-eminent in carving jade as is testified by the wonderful, beautiful and interesting carved objects in the Heber R. Bishop Collection in the Metropolitan Museum of Art, New York, and in the collections of the museums of Boston, Chicago, Paris, Berlin and Petrograd. The Russian objects are usually of stupendous size; the Chinese objects scarcely ever a foot high; some of the Russian works are from two to six feet long. Notable are the sarcophagus of Tsar Alexander II, and other work in the Imperial collections or among the Imperial gifts of the Russian tsars.

Nephrite is much tougher than jadeite, and as an illustration of its extraordinary toughness Dr. Heinrich Fischer relates* that he placed a large block of jade under a steam hammer, and that as a result of the blow the anvil on which the stone rested was broken, while the stone itself was unharmed. This illustrates the great difference between hardness and toughness, for although the diamond has a hardness of 10 against 6.5 of nephrite, the former would have been broken to splinters by such a test.

Owing to the shutting down of the European lapidary works due to the World War, the eastern Chinese lapidaries were called upon to supply the deficiency. The chromium-colored jadeite, because of its great beauty, has come into high favor, especially the rich translucent emerald green and yellowish green jewel-jade for bead necklaces, some of which have been sold for $20,000. Carved ornaments of jadeite have sold for from $500 to $2,000. Jade thumb-rings were formerly bought by wealthy Chinese for from a few dollars to $15,000 each. The exports of Burmese jadeite in worked form from China during the five-year period 1914–18 have been valued at about $2,000,000.

Turquoise is a phosphate of lime colored with copper, found for many centuries in the

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* Tschermak's 'Mittheilungen' (1872, 2. Heft, p. 135); consult also Fischer's 'Nephrit und Jadeit', (Stuttgart, 1880, pp. 294, 299).

Nishapur district, near Meshed, Persia, where it is highly valued and is sold in great quantities, from gems weighing many carats each to minute, round discs not more than one or two millimeters in diameter. It is found also in the Sinai Peninsula, where the mines were worked by the Egyptians almost as far back at 4000 B.C. The color is a more intense blue than that of any other stone. In China, where it is worked into Oriental objects, it is found in great masses, weighing many pounds each, but impure. Gem turquoise occurs also in New Mexico, Arizona, Nevada and California as well as in Mexico, and it was used by the pre-Columbians for ornament as well as in mosaics in combination with various colored shells or obsidian and for the decoration of human skulls, daggers, clam shells and other objects. Many of these are of great beauty. As a ring stone the beautiful color of the best turquoise makes it a great favorite. In order to preserve the color, it is desirable to exercise care in subjecting turquoise to contact with liquids. In the Middle Ages, and later, the superstition prevailed that the wearer of a turquoise would be protected from injury by falls. In the 16th century this was called the Turkey stone, as it came to Europe from Persia via Turkey; the name was then converted to turquoise.

Benitoite, a titano-silicate closely related to titanite, a deep blue gem from California, is so named from its occurrence on the Mount Diablo Range in San Benito County. When cut, its beautiful blue color resembles that of the sapphire, which it exceeds in brilliancy because of its higher refractive power.

Lapis-lazuli was valued as gem-material at a very early date and is mentioned as an article of tribute on Assyrian tablets of the second millenium before Christ. The stone is of a rich blue color and is a complex mixture of minerals, the most important constituent being lazurite. It was originally used to produce the pigment ultramarine. Its average hardness is only about 5.5. Many of the old Egyptian scarabs and amulets are made of it and a proof that its beauty was greatly prized by the Assyrians is given in a hymn addressed to the moon-god Sin, where he is said to be «bright as lapis-lazuli» (*uknu*). Some of the earliest Babylonian cylinders were of this stone and down to the present time it has been highly valued for its rich and beautiful color. One of the chief sources has been the mines of Badakshan, in the northwest part of Afghanistan, near the upper reaches of the Oxus. Still more ancient mines have been discovered in the valley of the Kokcha, a tributary of the Oxus. These mines have been worked for about 6,000 years and are evidently the oldest mines in the world. Near Lake Baikal in Siberia, especially along the river Malaya Bistraya, there are also productive mines and material of a somewhat inferior quality has been found in the Chilean Andes of Ovalle near the watershed between Chile and Argentina. At this locality masses of several hundreds of pounds each have been found, but much white limestone permeates the lapis-lazuli. The stone designated «sapphire» by the ancient Greek and Roman authors was probably lapis-lazuli.

Malachite is a basic carbonate of copper, with a hardness of three and one-half to four. It is an aggregate of minute crystals, is opaque in the mass and is capable of taking a very good polish. Ornamental objects of various kinds have been made of this material, its wonderful variety of rich green hues and its artistic markings enabling the lapidary to produce most attractive effects. Most of the fine work in this stone has come from the Imperial Russian lapidary works at Ekaterinburg, where a wealth of vases, bowls, table-tops, etc., have been made. The Medno-Rudiansk mine at Nizhni-Tagilsk furnished in 1836 the largest block of malachite that has ever been extracted. Its dimensions were: length, 10½ feet, width, 8 feet, height 3½ feet; the estimated weight was from 25 to 30 tons. As many as 125 horses were used to haul this mass from the mine to Ekaterinburg.

Amber, which the ancient Greek poets derived from the tears annually shed over the death of their brother Phaëthon by the Heliades, is not a mineral but a vegetable substance, the fossilized resin of pine trees of far distant times; it has been and is still used in a variety of ways for decorative purposes, more especially in the form of beads to be strung as necklaces or rosaries. Example of such beads have been found among the remains of the most ancient civilizations and they have been worn by almost all races and at all periods. The hardness of amber slightly exceeds that of gypsum, being about two and one-half, and it is thus easily shaped. It is quite strongly electric and this quality may have given rise to the supposed curative effects to be secured by wearing amber necklaces and to the belief of luxurious Romans that a cooling sensation was experienced by holding an amber ball in the hand. In Mohammedan countries many of the long rosaries carried or worn by the followers of Islam are composed of 99 amber beads. The broad distinction between «clear» and «cloudy» amber, the former of a pure, light yellow hue and quite transparent, the latter, passing through different degrees of opacity, variously marked and shaded and ranging in hue from whitish-yellow to light-yellow, is that commonly employed, but a number of special designations are used in the amber industry. An interesting feature in some amber specimens is the inclusion in the fossil resin of insects or plant forms, that must have become imbedded in the substance while in a fluid state and thus have preserved for us the exact appearance of insects that died thousands of years ago. Cloudy amber can be clarified by heating it in oil, the latter being absorbed through the pores of the amber and rendering it more highly refractive. Another method of clarifying is by burying the amber in sand and subjecting it to a heat of over 100° C. for a long period.

Phenomenal Feldspars. *Aventurine.*— There are three phenomenal feldspars: Sunstone (Aventurine), Moonstone and Labrador Spar or Labradorite. Of these the sunstone owes its peculiar beauty to the presence of spangles of either hematite, göthite or mica. The name has also been applied to a compact quartzite, usually red, brownish or white, with spangles of mica. This aventurine quartzite is found in several parts of Siberia, sometimes in masses weighing more than a ton and is called by the Russians «orletz.» Numerous vases, cups and ornaments are made of this material by the Russians and two great vases formed of it were presented, one to Sir Roderick Murchison and one to Baron Von Humboldt, when they visited Russia in 1850. A greenish or white quartzite, having spangles of mica, or a greenish chlorite, or both, is said to come from India and is occasionally sold as jade.

Californite is a compact variety of *vesuvianite*, named by George F. Kunz and is found in Siskiyou County, Cal. A somewhat similar variety was discovered in 1889, on the Piz Longhin, Canton Grisons, Switzerland. When cut *en cabochon*, its bright green hue acquires great brilliancy and resembles that of the nephrite variety of jade, for which it is occasionally mistaken.

Among the finest gem collections in the United States are the Tiffany-Morgan collection and the Bement-Morgan collections at the American Museum of Natural History, New York; the Isaac Lea collection, at the United States National Museum, Washington, D. C.; the Tiffany collection of the Field Museum of Natural History, Chicago; the Tiffany collection of the Golden Gate Museum, San Francisco, and the Kunz collection at the New York State Museum, Albany, N. Y. The foreign collections contain many fine gems and are in the collections of the British Museum; the Musée d'Histoire Naturelle, Paris; the National Mineralogical Collection at Vienna, Austria; the Mining Institute, Petrograd, Russia.

Bibliography.— King, 'Precious Stones and Metals'; Kunz, 'Gems and Precious Stones of North America'; Bauer, 'Edelsteinkunde'; Brauns, 'The Mineral Kingdom'; Eng. trans. by L. J. Spencer; Smith, 'Catalogue of the Gems of the British Museum'; Streeter, 'Precious Stones and Gems'; Kunz, 'Reports of the Department Mining Statistics'; United States Geological Survey, Bul. 1883–1905 in 'Reports on Precious Stones,' in the annual Mineral Industry (Vols. I–XXVII, 1882–1918, New York).

George F. Kunz.

PRECIPICE, The, by Iván Aleksándrovitch Goncharóf, had for its chief purpose, even more distinctly than 'Oblómof' (q.v.), to present the eternal struggle between the East and the West — the contrast between the lethargy or indolence of the Russian and the enterprising spirit of European energy. The protagonist of the story suffers not so much from constitutional laziness as from vacillation, from lack of resolution. Raïsky had a good education and served for a time as a civil *chinovnik* at Saint Petersburg; but left his position as casually as he had accepted it. He had great ability as an artist but he never had the patience to finish the innumerable sketches that he began. He might have been a talented musician but his masters could not induce him to practise. He had no ambition and if he found nothing to interest him in reading he would lie all day in bed as if exhausted by hard labor. He owns a pretty estate on the banks of the mighty Volga and thither he goes to visit his Aunt Tatiana, who has managed it for him with remarkable ability. There the action of the story unfolds, especially connecting itself with a high bluff (*Obruif*) overlooking the wide stream, gliding peacefully between its overgrown banks, with here and there a bush-covered island. The bluff, or precipice, was once the scene of a murder and was believed to be haunted by a ghost. It occurs to Raïsky to make the place the scene of a novel and he writes at it in his usual desultory way, not realizing that the passion and the dramatic color which he is seeking to impart to his imaginary characters are all about him. He finds himself interested in Viera, the elder of the two young girls reputed to be his aunt's grandnieces, but in reality her grandchildren, the daughters of her own illegitimate child. Viera is under the almost hypnotic influence of Mark Volokóf, a political suspect, interned in the village and enjoying an evil repute as a thief and monster of iniquity. Volokóf can hardly be regarded as a type of revolutionist like Turgénief's Bazárof. He is an exceptional character, somewhat overdrawn in his moral obliquity, but not impossible. In spite of Viera's appeal to Raïsky to save her from this human wolf, Volokóf succeeds in his dastardly purpose; but the girl finds an unexpected sympathy in Aunt Tatiana, whose own tragic story is revealed, bringing redemption to both of them. Raïsky, finding his love for Viera hopeless through his own fault, throws aside his unfinished novel and goes to Italy to take up sculpture as a consolation. The minor characters are admirably drawn and the subordinate strands of the romance are woven in with skill against a charming background of the Volga. 'Obruif' was published in the *Vyestnik Yevropui* (*The European Messenger*) in 1868–69, just 20 years after 'Oblómof.' An English translation by M. Bryant was published in London in 1916.

Nathan Haskell Dole.

PRECIPITATE, in chemistry a solid body produced by the mutual action of two or more liquids. Thus if sulphuric acid be added to an aqueous solution of barium chloride, barium sulphate is produced, and being insoluble in the menstrua present it precipitates or sinks as a solid to the bottom of the liquid in the vessel. So again, if a solution of potassium iodide be added to a solution of lead chloride, a reaction takes place resulting in the formation of lead iodide and potassium chloride, and inasmuch as the former of these bodies is, under the circumstances, a solid, it is precipitated. As a general rule it may be laid down that if it is possible to produce an insoluble solid substance by the action of two liquids on one another, that solid will be produced when these liquids are mixed, and that therefore a precipitate will be formed.

PRECOCITY, prē-kŏs'ĭ-tĭ, an early mental development, surpassing the normal. Generally speaking the precocious child differs from the prodigy in that his attainments constitute an actual acquirement rather than an intuitive possession of knowledge; and the precocious child presents a general development of the mental faculties instead of a supernormal development in a special line, as music, mathematics or other arts and sciences. Precocity may be the result of either training or natural endowment and the course of the educator toward it is usually that of fostering a general development, at the same time exercising care in avoidance of physical overstrain. Precocity has sometimes been held an indication of general physical weakness or inherent physical infirmity and likewise as having a deleterious influence upon adult attainments. As a rule, however, such unfortunate results may be ascribed to undue forcing, although the precocious child is no more immune to physical ills than any other. When due discretion is observed in its training the trait may generally be welcomed. It by no means presages genius, but on the other hand a preponderance of geniuses have possessed it. The need for modifying educational methods to meet the requirements of the supernormal individual so as not to retard his natural development and at the same time avoid overstimulation is one that has for some time engaged the attention of educators and physicians. Consult Donaldson, H. H., 'Growth of the Brain' (London 1895); Sully, J., 'Genius and Precocity' (1886); Galton, F., 'Hereditary Genius' (London 1892); Constable, F. C., 'Poverty and Hereditary Genius' (London 1905).

PREDESTINARIANS. See RELIGIOUS SECTS.

PREDESTINATION is the doctrine of God's will and counsel as revealed in the decreed redemption of mankind. It includes in its scope two significant facts, namely, his beneficent and allwise purpose and plan in reference to those who are fore-known and forechosen to the enjoyment of eternal salvation; and his fixed, determinate attitude toward those who are permitted to perish in their sins. This doctrine, as thus defined, has been the subject of intense theological controversy, because of the many essential and apparently contradictory personal features involved in it. And yet its history, as it appears in the rise and development of Calvinism over against Pelagianism, gives evidence of the logical connection which it has with biblical and metaphysical truth.

The sources of this tenet are set forth in the Old and New Testament Scriptures. From the earliest times of the human race, the God who «upholds, directs, disposes, and governs all creatures, actions, and things, from the greatest even to the least,» is manifestly a potent personal factor in the world. His wisdom and might, his love and grace, are wondrously and sublimely illustrated in the lives and movements of his chosen people. Every stage of their history, in the genesis and growth of their civil and religious institutions, to the closing tragedy of the life of Jesus Christ, furnishes a series of pictures of the divine method of government, as they are painted by his artist hand. Indeed, so evident is his own mind and purpose throughout the execution of his salvatory plan, that his nature, life and love at once and forever become inseparable elements within the domain of the human universe. And this is fully indicated (1) by the perfection of his nature; (2) in the marks of his infinite wisdom, power, holiness, etc.; (3) in the operations of his will, thought and counsel; (4) in prophetic utterances and their fulfilment; (5) in the coming of Jesus Christ, the true representative of God; (6) in the unchangeable provisions of the redemption wrought out through him; (7) in the actual salvation of men from their sins; (8) in the establishment, upon a sure foundation, of the *Fact* of eternal life!

The historic birth of this doctrine can be traced to the fertile brain of Origen, who possibly was its first supporter, although he did not fully accept the second portion of it, which consigns the unsaved to conditions of everlasting reprobation. From his time to the Augustinian Age there was little controversy over the sovereignty of God in its relation to man's freedom and salvation. But during Augustine's sway, in the Western Church, the doctrine of man's inability to save himself and his absolute dependence upon God's eternal decree to be saved, was so strongly and vigorously taught that Pelagius, who represented opposite theological tendencies, declared that the true fundamental conception of sin involved man's capacity of choice to be good or evil, apart from God's plan and grace. This controversy was waged with great earnestness — especially in the Greek Church — for half a century, till it was modified under the form of Semipelagianism.

Later theologians divided themselves into two groups, the Infralapsarians and the Supralapsarians. The former taught that the decree of predestination had no effectiveness until after man's fall, while the latter class held that the ultimate end which God had in mind was his own glorification in the salvation of some and in the reprobation of others.

During the Reformation the strongest exponents of the true predestination idea were the Calvinistic thinkers under the leadership of John Calvin (1509), though the Lutherans and Arminians also accepted the doctrine in a less rigid form. Calvin's doctrinal ideas were incorporated in his greatest masterpiece, 'Institutes of the Christian Religion' (1535). The main features of this scholarly production, aside from the dissertations upon church, state and religion, are embodied in the doctrines of plenarv inspiration of the Bible, free-will and predestination. Here God is the centre and man the object of his voluntary interest and love. But in this relation he is confessedly to be dealt with according to his Creator's established order. Everything in and about him which is out of harmony with that order must be adjusted or rejected. In this process of correction or of salvation God acts alone. Man is a passive agent without the power of free-will. His predestined salvation or reprobation depends upon the unlimited might and wisdom of God. Hence predestination is a divine necessity.

This view of predestination was presented more philosophically and clearly by Calvin in his catechism published at Geneva (1545). And it was this treatise, without a doubt, that, a century later, furnished the Westminster divines the foundation outlines for the Standards which they drew up in England's great Abbey of Westminster during the years 1643–48. The three products of that representative body called by the English Parliament and made up of the most eloquent, pious and scholarly divines, Lords, Commoners and commissioners from every county of England and the universities of Oxford and Cambridge, are the Westminster Shorter and Larger Catechisms and the Westminster Confession of Faith.

In each one of these the doctrine of predestination is set forth, but more especially so in the 3d and 10th chapters of the Confession of Faith, which respectively treat «Of God's Eternal Decree» and «Of Effectual Calling.» The paragraphs in these chapters that most pointedly outline the doctrine read as follows:

III. By the decree of God, for the manifestation of his glory, some men and angels are predestined unto everlasting life and others foreordained to everlasting death.

IV. Those angels and men, thus predestined and fore-ordained, are particularly and unchangeably designed; and their number is so certain and definite that it cannot be either increased or diminished.

As early as in the year 1831 the general assembly of the Presbyterian Church was confronted with the demand for more liberty in the interpretation of the Creed of the Fathers. The marshaling of the forces who stood for a change in the form of statement, involving the doctrines of election and predestination, continued, as shown by the famous heresy trials of Drs. Barnes, Swing, Smith and Briggs. After their deposition from the Presbyterian fold, the consideration of a revision of its standards became a matter of serious importance. In view of this the general assembly of 1889 resolved to transmit an overture to the presbyteries, asking them to consider the propriety of a revision of the Confession of Faith. The result of this action brought about the sentiment in favor of a revision. The assembly of 1891 now asked the presbyteries for more suggestions. Again the answer came by a large majority of Presbyterial votes for a revision.

In 1893 the assembly was importuned once more for a new and shorter creed, but it voted to lay the matter aside. The battle of the theological giants did not cease at this. Again they pressed to the front. In consequence, the general assembly of 1900 appointed a large committee to reconsider the matter of revision. After seven months they reported that «the returns indicated plainly that no change is desired which would in any way impair the integrity of the system of doctrine contained in the Confession of Faith.» In spite of this negating motion, the general assembly of 1902–03 added the Declaratory Statement to chapters III and X, which reads as follows:

«With reference to chapter III of the Confession of Faith: that concerning those who are saved in Christ, the doctrine of God's eternal decree is held in harmony with the doctrine of his love to all mankind, his gift of his Son to be the propitiation for the sins of the whole world, and his readiness to bestow his saving grace on all who seek it. That concerning those who perish, the doctrine of God's eternal decree is held in harmony with the doctrine that God desires not the death of any sinner, but has provided in Christ a salvation sufficient for all, adapted to all, and freely offered in the Gospel to all; that men are fully responsible for their treatment of God's gracious offer; that his decree hinders no man from accepting that offer; and that no man is condemned except on the ground of his sin.»

PREDICABLES, term of the Aristotēlian system of logic, denoting a class of concepts which may be predicated affirmatively of several others; it is now obsolete. The predicables are five in number, namely, *genus, species, differentia, proprium* and *accidens*, and were used in classifying objects on a systematic plan. Every object was conceived of as belonging to some species and that to some genus; objects in the same genus — a dog and a wolf, for example, would belong to different species because of the *differentia* between their characters — the specific *differentia;* a property (*proprium*) would form a ground of difference between members of the same species, *proprium* expressing, not an ultimate distinction, but one resulting from some other character, for example, the peculiarity of the shepherd dog, which is founded in the dog's natural sagacity; *accidens* is something not inherent in the nature of the object, but incidentially present in it, for example, the high value of the diamond. See LOGIC.

PRE-ESTABLISHED HARMONY, The Doctrine of, the philosophical theory of Leibuity as presented in his doctrine of the monads, which has as its purpose the explanation of the universe as composed of various orders of self-active beings. His belief is that the forces of nature are not externally controlled and that the action of no single monad is influenced by another but was destined by God from the beginning to work out its individual progress unaffected by any other and toward an end of perfect harmony which is preëstablished. The monads include the physical elements with their chemical affinities and plants with their sentient life, up to the class of humans with souls and power of thought. The soul becomes the dominating monad in human existence, while God is the *monad monadum*. The theory involves a progressive independent development of the monads toward ultimate perfection and regards evil as an evanescent quality in no way conflicting with sure progression of God's original plan. The theory obviates any necessity for interference by the Deity. While of necessity conjectural in its conclusions it is regarded as one of the most profund treatises of philosophical theology in existence. Leibnitz left no elaborate exposition of his theory, its most complete summary being that he prepared for Prince Eugene of Savoy in 1714. See LEIBNITZ, GOTTFRIED WILHELM.

PREFECT, or **PREFET**, the title of a high civil official in France, created by a law of the 28th Pluviôse in the year VIII (17 Feb. 1800). It was derived from the old Roman title Praefect (q.v.). There were 86 prefects in modern France, each at the head of the civil administration of a departément. The prefect is an official of considerable power, although his prerogatives have been curtailed at various times since they were first established. He is appointed by the President and must be a French citizen. There are three classes of prefects, according to the size and importance of their departément, with salaries ranging from 18,000 to 35,000 francs. The prefect is the chief representative of the government, whose decisions, laws and regulations he executes. Though directly responsible to the Minister of the Interior, he supervises all governmental institutions and services in his departément. He exercises considerable control over the conseil général, mayors and municipal councils of his departément and possesses great power in respect to the administration of the police and of public institutions, both charitable and otherwise. Formerly he enjoyed almost unlimited powers in regard to the management of his départément's local interests. These, however, have now been transferred to a great extent to the conseil général and to a départémental committee, elected by the former for the interval between its sessions. Under the prefects serve sous-préfets of which there are 362, each at the head of an arrondissement, a subdivision of the départément. Various attempts to discontinue these officials, made on the part of the Chamber of Deputies by refusing to vote the amounts required for their salaries, have failed. Consult Haas, C. P. M., ‘Administration de la France’ (Vol. II, Paris 1861); Larroque, P., ‘De l'Organization du Government Republicain’ (Paris 1870); Monnet, Emile, ‘Histoire de l'Administration en France’ (Paris 1885); Dethan, Georges, ‘De l'Organisation des Conseils Généraux’ (Paris 1889); Lowell, A. Lawrence, ‘Governments and Parties in Continental Europe,’ Vol. I (Boston and New York 1896); Bodley, J. E. C., ‘France’ (New York 1898); Imbart de la Tour, Jean, ‘Les Conseils de Préfecture’ (in ‘Annales des Sciences Politiques,’ Vol. XIV, p. 215, Paris 1899); Rudloff, H. L., ‘Die Entwickelung der Selbstverwaltung Frankreichs im 19 Jahrhundert’ (in ‘Zeitschrift für die Gesamte Staatswissenschaft,’ Vol. LXI, p. 193, Tübingen 1905); Garrigues, J., ‘La Question de la Suppression des Sous-Préfets’ (Faculté de Droit de l'Université de Paris, Paris 1909); Caudel, M., ‘Nos Libertés Politiques’ (Paris 1910); Haas, J., ‘Frankreich, Land und Staat’ (Heidelberg 1910); Poincaré, Raymond, ‘How France is Governed’ (London 1913); Jèze, G., ‘Das Verwaltungsrecht der Französischen Republik’ (in ‘Das Öffentliche Recht der Gegenwart,’ Vol. XXIII, Tübingen 1913); Lachapelle, Georges, ‘L'Œuvre de Demain’ (Paris 1917).

PREFERENTIAL BALLOT. See BALLOT.

PREFERENTIAL VOTING. See VOTE, VOTERS, VOTING; ELECTIONS.

PREFORMATION, a theoretical view of embryological development widely held in the 17th century, and especially advocated by Haller. It asserted that the germ held in infinitesimal proportions all the parts and organs of the being, which were simply unfolded by growth. Hence this theory came to be known in England as the «evolution» theory and in French literature as the *emboîtement* theory. One class of thinkers regarded the egg as containing the whole of the embryonic material; another class thought it all contained in the spermatozoon. This whole baseless fabric of philosophy was overthrown by the microscopical researches of Wolf and the other founders of the science of embryology (q.v.).

PREGNANCY. See ABORTION; MENSTRUATION; OBSTETRICS.

PREHISTORIC MAN. See MAN, PREHISTORIC RACES OF.

PREHNITE, or EDELITE, a mineral, allied to zeolites and usually found with them, white or pale-green with a vitreous lustre, crystallizing in the orthorhombic system. It is a hydrous silicate of aluminum and calcium, having the formula $H_2Ca_2Al_2Si_3O_{12}$. It is most frequently found in rocks of the basaltic type and is obtained from a wide area, being found in the copper region of Lake Superior, at Paterson and Bergen Hill, N. J., in Scotland, France, China and South Africa. It was first found by Colonel Prehn in the 18th century at the Cape of Good Hope. It is cut into gems and slabs, resembling chrysoprase in appearance. Its hardness is 6–7, its specific gravity 2.8–3.

PRELATE, a term used generally of bishops and archbishops of the Anglican communion, but bearing a more precise and specific meaning in the Roman Catholic Church, where it is applied to secular or regular clergy, who have a jurisdiction inherent in their office, and not merely delegated by a superior. The title is especially used of the prelates of the pope's court and household; prelates of the Curia, who hold higher rank than other prelates, have the title «Monsignore» and may wear apparel of violet color.

PRELL, prĕl, **Hermann,** German painter and sculptor: b. Leipzig, 29 April 1854. He studied at Dresden and Berlin under Grosse and Gussow respectively, supplementing this by a course of study in fresco painting in Italy. He soon became one of the foremost German fresco painters of historical subjects. Returning home he was commissioned to paint the frescoes in the banquet hall of the House of Architects, in Berlin, and for this hall he executed in 1881–82 a series of 11 paintings on the ‘Main Epochs of the History of Architecture.’ His other mural paintings are to be found in the City Hall of Worms (‘Justice,’ ‘Valor’ and ‘Henry IV Granting Privileges to Worms in 1074,’ painted in 1884); the City Hall of Hildesheim (1887–81); City Hall of Dantzic (1892); the Breslau Museum (1893–94); Palazzo Caffarelli in Rome (1895–98); the Albertinum, Dresden (1901–05); the City Hall of Dresden (1908–12); sculptures by him are in the new Dresden City Hall and in the Albertinum, Dresden. He has also done some mosaics in the Cotton Exchange and in the North German Lloyd Building in Bremen (1911), and in the Staendehaus in Dresden (1907). The Dresden Gallery and the Breslau Museum contain specimens of his easel pictures. He has taught in the academies of Berlin and Dresden. In 1893 he received the Great Gold Medal at the Berlin Exhibition. He has published ‘Die Fresken im Rathause zu Hildesheim’ (Hildesheim 1894). Consult Ianitsch, ‘Die Fresken im Treppenhause des Schlesischen Museums der Bildenden Kuenste’ (Berlin 1895); Meissner, F. H., ‘Hermann Prell’ (Wien 1897); Rosenberg, A., ‘Hermann Prell’ (in ‘Kuenstler Monographien,’ Vol. LIII, Leipzig 1901).

PRELLER, prĕl'lĕr, **Friedrich,** German painter, son of the following: b. Weimar, 1 Sept. 1838; d. Dresden, 21 Oct. 1901. After studying under his father and later in Rome, he traveled much in Switzerland, France and Italy and painted landscapes. His wall-paintings in the new theatre at Dresden (especially his ‘Prometheus’ and ‘Iphigenia’) and in the Albertinum at Dresden (‘Olympia’; ‘Pergamus’; ‘The Acropolis at Athens,’ and ‘Ægina’) have been much admired. He also produced a series of landscapes, scenes from Italy and Greece, in oil. His ‘View of the

Monastery of Santa Scholastica' and some other landscapes are in the Dresden Gallery, his 'Sappho' in the museum at Leipzig. In 1867 he became professor in the Art Academy at Dresden.

PRELLER, Friedrich Johann Christian Ernst, German painter: b. Eisenach, 25 April 1804: d. Weimar, 23 April 1878. In the same year in which he was born, his parents moved to Weimar where he became acquainted with Goethe in his youth, and received encouragement and finally a pension from the Grand Duke Karl August of Weimar which enabled him to travel and study from 1826–31 first in Holland and later in Italy where he imbibed more from the classic than the Renaissance art and formulated a pictorial philosophy in which he saw man as the culmination of all earthy beauties. His important works, especially the series suggested by Homer's Odyssey, now in the Museum of Weimar, are bold and vigorous landscapes forming a setting for nude figures of heroic mold. To paint such subjects was the necessity of his artistic creed; yet he frequently turned to other fields, partly for financial reasons, partly because of his deep interest in and love of all phases of nature. In 1840 he made a sketching trip to Norway, and frankly adopting the naturalism of Ruysdael, of whom he had been an ardent admirer since his early youth and one of whose pictures he copied when he first began seriously the study of painting, he painted landscapes for sale. Even these were vigorous and meritorious in execution, if not fully representing his genius. He made unremitting sketches from nature and left behind him a long series of remarkable drawings. In later years he made other journeys to Italy, though most of his time was spent in Weimar where he taught at the Art Academy. Besides the Odyssey landscapes he also painted frescoes in the Wieland room of the Weimar palace showing scenes from Oberon. Paintings from his brush are to be seen in the National Gallery at Berlin and in museums at Weimar, Dresden, Leipzig, Stuttgart and Munich. He was also interested in etching and etched many of his own paintings. Consult Gensel, J., 'Friedrich Preller d.Ä.' (in 'Künstler Monographien,' Vol. LXIX, Leipzig 1904); Roquette, 'Friedrich Preller' (Frankfurt a.M. 1883).

PRELUDE, in music, a short introductory strain preceding the principal movement, performed on the same key as it, and intended to prepare the ear for the piece that is to follow. It may consist of a series of unconnected chords when the intention is simply to attract the attention of an audience, or to fill a singer's ear with the key in which the piece is written, in which case it is generally improvised. It is, however, usually composed of part of the leading theme, more or less varied toward the close, and is not left to the invention of individual performance. Among classic models are the preludes to Bach's fugues and the preludes written by Chopin and Mendelssohn. See MUSIC.

PRELUDE, The. 'The Prelude or Growth of a Poet's Mind,' a blank verse poem in 14 books, was written by Wordsworth between the years 1799 and 1805, and was published posthumously in 1850. The work was intended to be introductory to a long philosophical poem, 'The Recluse,' of which the second part alone, viz., "The Excursion," was completed. In 'The Prelude' Wordsworth, addressing his friend, Samuel Taylor Coleridge, passes in review his own development as a poet, taking account of the circumstances which influenced him and analyzing the spiritual changes through which he passed. From the point of view of content the work may be classed with such autobiographies as Goethe's 'Dichtung und Wahrheit' and Coleridge's own 'Biographia Literaria.' Throughout the work Wordsworth is chiefly occupied with defining the influence of nature as a determining factor in his spiritual life. As in 'Tintern Abbey,' he distinguishes several stages in his relation to nature. In his early youth he is a thoughtless boy, using nature as the companion of his sports. There is no conscious nature love, but at intervals amid his sports there come to him moments of vision, "gleams like the flashing of a shield," and nature seems to him a living thing. A second stage is reached when nature, hitherto secondary in his thoughts, is sought for her own sake, with conscious love; his imagination now leads him to see in nature the reflection of his own soul and to feel "the sentiment of being spread o'er all that moves and all that seemeth still." His residence in Cambridge comes as a partial interruption of his communion with the divinity in nature, but on his return to the scenes of his childhood during a summer vacation he experiences a renewal of his old affection and reverence, and now, too, he begins to interest himself in the human life about him. The incorporation into his thought of the sense of humanity marks a third step in his spiritual evolution. He becomes conscious also at this time of his mission as a poet. During the years which follow, Wordsworth passes through the great crisis of his life. He is caught up by the revolutionary enthusiasm while in France, and for the time being entirely loses sight of the earlier vision in his devotion to the new movement for the regeneration of society. But as the revolution progresses, Wordsworth, like other idealists of his time, begins to lose faith in it. He turns to abstract reason for comfort, becomes hopelessly entangled in the mazes of fruitless speculation, and ends in intellectual despair. From this condition he is rescued by renewed contact with the soothing influences of nature and by his sister, who leads him gently back to the life of feeling and restores in him the spirit of joy and love. The emotions are now more precious to him than the intellect, and he regains possession of the creative vision of his youth. But henceforth humanity occupies a position in his heart higher even than that of nature.

'The Prelude' is very important for the understanding not only of Wordsworth himself but of the spiritual history of his generation. It is, moreover, a poem of great beauty, abounding in descriptive and philosophical passages written in Wordsworth's most exalted manner, and containing a relatively small proportion of the pedestrian element which is apt to mar his longer works. Consult 'Poetical Works,' edited by W. Knight, 1882–89; 'The Prelude,' edited by G. C. Moore Smith [Temple Classics]; other editions are common. The best commentary on 'The Prelude' is E. Legouis' 'The Early Life of Wordsworth,' translated by J. W. Matthews. A selected bibliography of Wordsworth criticism may be found in Page's 'British Poets of the Nineteenth Century,' also in 'Cambridge History of English Literature' (Vol. XI).

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PREMIUM PLAN, a system of wage bonus awarded a worker for completing a certain amount of work in less than the standard time allowed for it. The plan has been adopted in very many industrial establishments where there is a wage scale fixed by collective bargaining such as are becoming general under modern trades-union conditions. Henry R. Towne was the first to promote the plan in the United States in 1889 calling it "gain sharing." Two years later it was adapted to specific industries by F. A. Halsey. Since that time many modifications have been introduced, nearly all of which had regard to the proper adjustment of the standard time to be allowed for a specified task. James Rowan, of Glasgow, introduced a system of making the time saved on a task a percentage of the standard and then applying the percentage to the actual time. Under the Rowan plan the total earnings of a worker cannot be more than twice the regular fixed day-rate. See Wages.

PREMONSTRATENSIANS, or NORBERTINES, a religious order, founded by Norbert, canon of Xanten in Cleves, who on account of his zeal as archbishop of Magdeburg in 1127 was canonized. In the forest of Saint Gobain, in a meadow pointed out to him, as he said, by Heaven (*prémontré, pratum monstratum;* thence the name of the order), he collected his first disciples (1120). The original establishment was built by the bishop of Laon. It contained 40 members who wore the white habit and cloak of canons regular and lived, according to the rule of Saint Augustine, a strict conventual life. In 1125 they were formally approved by Pope Honorius II. The order is composed of three classes: (1) priests and clerics under an abbot or provost; (2) nuns who embrace the rule of Saint Norbert; (3) lay members. Their order increased rapidly; several nunneries were established with the same rigid rules. The abbot of the original monastery Prémontré, near Coucy, was general, and with three other abbots formed the great council of the fathers of the order. The order was introduced into England in 1143 at Newhouse in Lincolnshire and its members were there regularly known as the White Canons. Some time before, in 1125, King David of Scotland had brought a colony to his kingdom. Before the Reformation they are said to have had 1,300 monasteries, among which were 500 nunneries, mostly in Germany, the Netherlands, France, England and the north of Europe; but the Reformation diminished this number by more than one-half in the 16th century. In the 18th century the order lost many of its houses as a result of the French Revolution and at the end of the century there were only 27 houses in existence. It now consists of eight houses in Holland and Belgium, seven in Austria, two in Hungary, three in England, one in the United States and one in Canada. There are also eleven nunneries in Holland, Belgium, Spain, Austrian and Russian Poland, Switzerland and Bohemia. Some of these monasteries have founded priories in Brazil to which colleges are attached, others are doing missionary work in the Belgian Congo and in Madagascar. The entire order is divided into five circaries. At its head is a superior-general, the most recent one being Norbert Schachinger, abbot of Schläge, one of the Austrian monasteries of the order." In 1913 the membership of the order was made up of one bishop, 17 vicars, one apostolic praefect, 789 priests, 129 scholastics, 51 novices, 91 lay brothers and three lay novices. In modern times the order has become very active in teaching boys in high schools and academies. It possesses a college for its own members at Budapest and one at Rome, the head of the latter being the procurator of the order. The provincial house of the Premonstratensians in the United States was founded at West De Pere, Wis., by fathers from the abbey of Heeswijk, Holland. The very Rev. B. H. Pennings, O. Praem., is the present prior. The fathers conduct missions in the archdiocese of Chicago and the dioceses of Green Bay, Grand Rapids, Marquette and Helena, as well as a flourishing classical and commercial college. The membership in 1918 consisted of 28 clerics, six scholastics, four novices and four lay brothers. Consult 'Statuta Sacri et Canonici Præmonstratensis Ordinis, Renovata Jussu Regis Christianissimi, et Auctoritate Capituli Nationalis, Anni 1770' (Paris 1773); Currier, 'History of Religious Orders' (New York 1894); Gasquet, Rev. F. A., 'The English Premonstratensians' (in Transactions of the Royal Historical Society, n. s. Vol. XVII, p. 1, London 1903): Grassl, B., 'Catalogus Generalis Totius Sacri Candidi, etc.' (Pilsen 1912); Heimbucher, M., 'Orden und Kongregationen' (Paderborn 1907); Helyot, P. and M. Bullot, 'Histoire des Ordres Religieux' (Paris 1714–19); Kirkfleet, Rev. C. J., 'History of Saint Norbert' (Saint Louis 1916); Winter, F., 'Die Praemonstratenser des 12 Jahrhunderts und ihre Bedeutung für das Nordöstliche Deutschland' (Berlin 1865).

PRENCE, prĕns, or **PRINCE, Thomas**, American colonist: b. Lechdale, Gloucestershire, about 1600; d. Plymouth, Mass., 29 March 1673. He was one of the Leyden band of Pilgrims which arrived at Plymouth on the ship *Fortune* 9 Nov. 1621, and his wealth soon gained for him considerable influence. In 1634 and in 1638 he was elected governor and was one of the assistants in 1635–37 and in 1639–56. He assisted in the settlement of Nansett or Eastham and from 1657 until his death was governor of Plymouth, the law requiring the residence of the governor in Plymouth being waived in his favor. He was also one of the commissioners from Plymouth at various times after the confederacy of the four colonies of Plymouth, Massachusetts, Connecticut and New Haven had been formed in 1643. He was zealous in the religious affairs of the colony, an active promoter of educational matters, and was the real founder of the public schools in New England. Consult Baylies, F., 'An Historical Memoir of the Colony of New Plymouth' (Boston 1866); Morton, N., 'New England's Memorial' (Cambridge, Mass., 1669); 'Mourt's

Relation or Journal of the Plantation at Plymouth’ (London 1622).

PRENDERGAST, Edmond Francis, American Roman Catholic prelate: b. Clonmel, Ireland, 3 May 1843; d. Philadelphia, Feb. 1918. He came to the United States in 1859; was educated at the ecclesiastical seminary of Saint Charles Borromeo, Philadelphia, and was ordained to the priesthood in 1865. He was successively at Saint Paul’s, Philadelphia, Susquehanna Depot and rector of Saint Mark’s, Bristol, Pa., for four years. Until 1874 he was rector at Allentown, Pa., and from 1874 to 1897 was rector of Saint Malachy’s, Philadelphia. In February 1897 he was consecrated auxiliary bishop of Philadelphia and in May 1911 became archbishop in succession to Dr. Ryan.

PRENDERGAST, Maurice Brazil, American artist: b. Boston, Mass., October 1861. He studied at Julien and Colorossi academies and at the École des Beaux Arts, Paris, under Joseph Blanc, Courtois, Jean Paul Laurens and Jerome. He returned to the United States and settled in Boston, removing to New York in 1914. He works both in oil and in water color, and his favorite subject is a grouping of figures against a landscape background. He is noted for his vivid coloring, his joyous vision of nature and his unconventional but truthful presentation. His strength in design and individuality in execution are remarkable. Among his works may be mentioned ‘Crepuscule,’ ‘Chrysanthemum Market,’ ‘On the Cliffs,’ ‘The Merry Maidens,’ ‘Seashore,’ etc.

PRENTICE, prĕn’tĭs, **George Dennison,** American journalist: b. Preston, Conn., 18 Dec. 1802; d. Louisville, Ky., 22 Jan. 1870. He was graduated from Brown University in 1823; studied law, but did not practise, and was editor of the *New England Weekly Review* at Hartford, a literary journal, 1828–30. He then removed to Louisville, Ky., where in November 1830 he founded the Louisville *Journal* and became its first editor, in which position he won widespread reputation for political ability, wit and satire. For many years the *Journal* was a leading advocate in the West of the policy of the Whig party, and at the outbreak of the Civil War maintained with zeal the cause of the Union. A collection of his poems appeared in 1876 and a selection from his newspaper paragraphs under the title of ‘Prenticeana’ in 1860.

PRENTISS, Benjamin Mayberry, American military officer: b. Belleville, Va. (now W. Va.), 23 Nov. 1819; d. Bethany, Mo., 8 Feb. 8 Feb. 1901. He removed with his parents to Missouri in 1835, and in 1841 settled in Quincy, Ill., where he entered the commission business. He served in the Mexican War with rank of captain, and received honorable mention for services at Buena Vista. At the outbreak of the Civil War he reorganized his old company, was appointed colonel of the Seventh Illinois regiment and in May 1861 was made brigadier-general of volunteers. He routed a band of Confederates at Mount Zion, southern Missouri, 28 Dec. 1861, joined General Grant a few days before the battle of Shiloh and was taken prisoner in that battle on 6 April 1862, together with most of his command, while stubbornly holding the position to which he had been assigned. He was released in October 1862, promoted major-general of volunteers in November 1862, served as a member of the court-martial which tried Gen. FitzJohn Porter, and in July 1863 defeated the Confederate forces under Holmes and Price at Helena, Ark. He resigned his commission in October 1863 and settled in Bethany, Mo., where he practised law.

PRENTISS, Elizabeth Payson, American author: b. Portland, Maine, 26 Oct. 1818; d. Dorset, Vt., 13 Aug. 1878. She was married to George Lewis Prentiss (q.v.) in 1845 and after the death of two children turned her attention to literary work. Her most popular work, ‘Stepping Heavenward’ (1869), reached a sale of over 150,000 in this country besides being translated into French, German, Norwegian and Italian, where it met with great success. Many of her other books, too, achieved great success and were translated into foreign languages. Among her other works are ‘The Susy Books’ (1853–56); ‘The Flower of the Family’ (1856); ‘Little Threads’ (1868); ‘Fred, Maria and Me’ (1868); ‘Nidworth and His Three Magic Wands’ (1869); ‘The Percys’ (1870); ‘Six Little Princesses and What They Turned Into’ (1871); ‘Aunt Jane’s Hero’ (1871); ‘Golden Hours’ (1873); ‘Urbane and His Friends’ (1874); ‘The Home at Greylock’ (1876); ‘Pemaquid’ (1877); ‘Gentleman Jim’ (1878); ‘Avis Benson’ (1879). Consult Prentiss, G. L., ‘Life and Letters of Elizabeth Prentiss’ (1882).

PRENTISS, George Lewis, American Presbyterian clergyman: b. Gorham, Maine, 12 May 1816; d. New York, 18 March 1903. He was graduated from Bowdoin College, Brunswick, Maine, in 1835, which gave him the degree of D.D. in 1854, studied theology in the universities of Halle and Berlin in 1839–41, and was ordained to the ministry in 1845. He was pastor of the South Trinitarian Church, Boston, 1845–50, of the Mercer Street Presbyterian Church, New York, 1851–58, when ill health compelled his resignation. In 1862 he established in New York the Church of the Covenant, and was its pastor until 1873, when he accepted the chair of pastoral theology, church polity and mission work at Union Theological Seminary. He published ‘A Memoir of S. S. Prentiss’ (2 vols., New York 1855); ‘A Discourse in Memory of Thomas Harvey Skinner’ (New York 1871); ‘Life and Letters of Elizabeth Prentiss’ (New York 1882); ‘The Union Theological Seminary in New York, Historical and Biographical Sketches of Its First Fifty Years’ (New York 1889); ‘The Agreement between Union Seminary and the General Assembly’ (New York 1891); ‘The Union Theological Seminary in New York; its Design and Another Decade of its History’ (Asbury Park 1899), etc. He also edited ‘Faith and Philosophy: Discourses and Essays by H. B. Smith’ (New York 1877).

PRENTISS, Sergeant Smith, American orator, brother of G. L. Prentiss (q.v.): b. Portland, Maine, 30 Sept. 1808; d. Natchez, Miss., 1 July 1850. He was graduated from Bowdoin College, Brunswick, Maine, in 1826, removed to Natchez, studied law, taught school, and in 1829 was admitted to the bar, after which he established a law practice, first in Natchez and later in Vicksburg, Miss., and rapidly gained high rank in his profession. In 1835 he was elected to the Mississippi legislature, where he won a reputation as an orator, and in 1837 he was elected to Congress, but upon arriving at Washington to take his seat found it occupied by the Democratic candidate, Colonel Claiborne. In a speech of great brilliancy and power, which continued for three days, he argued his case before the House, attracting the attention of the country to the «Mississippi Election Case.» The controlling vote was cast by the speaker, James K. Polk, and Prentiss was defeated, but at the polls in the election following was triumphantly elected. His speech against the sub-treasury bill sustained his reputation as an orator, but at the close of his term he declined re-election. In the campaign of 1840 he actively supported General Harrison, and in 1845 he strenuously opposed repudiation. In the same year, after suffering serious financial reverses, he removed to New Orleans, La., where he spent the balance of his life in the practice of law. Consult Prentiss, G. L., 'Memoir of S. S. Prentiss' (New York 1855).

PRENZLAU, prĕnts'low, or **PRENZLOW**, Germany, town in the province of Brandenburg, in Prussia, on the Ücker and Lake Ücker, 57 miles north by east of Berlin. It is divided by the river into an old and a new town, is well built and has among its buildings a handsome Gothic church (erected 1325–40), monuments of Emperor William I, Moltke, Bismarck and Grabow, some old city gates and a gymansium. Of interest is also the Ukermär Kósche Museum. It has a number of manufacturing establishments, machine shops, woolen mills, tanneries, sugar works, etc. In 1806 a Prussian corps under Prince Hohenlohe surrendered here after the battle of Jena to Murat. Pop. 21,431.

PREPOSITION. See GRAMMAR.

PREROGATIVE, in British law a term used to denote an exclusive privilege of the Crown, the expression the prerogative being employed for the whole or any part of such exclusive privilege. The prerogative may be confined or limited by the supreme legislative authority and has in fact been much restricted, notably by Magna Charta (1215), the Habeas Corpus Act (1679), and the Bill of Rights (1688). In a wider sense the term is used to denote a right attached to a rank or office to exercise certain powers or privileges to the exclusion of others. Consult Allan, John, 'Inquiry into the Rise and Growth of the Royal Prerogative in England' (2d ed., London 1849); Blackstone, Sir William, 'Commentaries' (4th ed., Chicago 1899); Chitty, Jos., the Y., 'A Treatise on the Law of the Prerogative of the Crown, etc.' (London 1820); Holdsworth, W., 'A History of English Law' (3 vols., London 1903–09); Stubbs, W., 'The Constitutional History of England' (3 vols., Oxford 1875–78).

PRESBYOPIA. See VISION, DEFECTS OF.

PRESBYTER. See BISHOP; PRESBYTERIANISM; etc.

PRESBYTERIAN CHURCH IN THE UNITED STATES OF AMERICA. The history of Presbyterianism in the United States is closely interwoven with that of the country at large. The early colonists were, for the most part, those who had crossed the ocean to find a home in the New World, in order to enjoy religious freedom. They came for conscience's sake, rather than for the advancement of their fortunes. They claimed the right to worship God according to the dictates of their own consciences and to govern themselves in the administration of church order and discipline. They were bitterly opposed to the claims of prelacy. Alike among the Congregationalists of New England, the Dutch of New York, the Scotch-Irish of Pennsylvania and the Huguenots of the Carolinas, the Calvinistic or Reformed system of doctrine was the prevailing belief. The Shorter Catechism of the Westminster Assembly, embodied in the New England Primer, had a more profound influence in the training of successive generations than any other book of that period, except the Bible. It was the working creed of the men who laid the foundations of free institutions in America. The organization of the church among the colonists was determined largely by their previous associations in the Old World. The New England colonists were mostly of English-Puritan extraction and favored the Congregational polity. There were, however, two parties among them; one zealously favoring Independency, the other leaning toward the Presbyterian polity. The former belonged to the school called Brownists, the latter to Barrowism. A strictly Presbyterian colony was established in Salem, Massachusetts Bay, under Roger Conant in 1625. Among those who held to Presbyterian views was Rev. Richard Denton, who came from England in 1630, and settled in Watertown, Mass. Driven out by opposition to his views, he removed in 1644, with some of his congregation, to Hempstead, Long Island, where a church was organized in accordance with the Presbyterian form. The earliest organization of Presbyterianism in the New World was made in the Dutch settlement of New Amsterdam, in New York, in 1628. It was a Reformed Dutch church and the first Protestant church in America. Other churches of this denomination were organized at an early date among the Dutch settlements. (See REFORMED DUTCH). While the Presbyterian element was found in all of the colonies from New England to Georgia, circumstances prevented its separate organization. In New England the prevailing form of government was Independency or Congregational; in New York Presbyterianism was of the Dutch type and only Episcopacy was allowed among the English. In Virginia, Episcopacy was established by law and was intolerant toward all forms of dissent. Conditions were more favorable to Presbyterianism in the provinces of Pennsylvania, New Jersey, Delaware and Maryland. To these colonies came a large number of emigrants from the North of Ireland and from Scotland. The religious intolerance prevailing under the reign of Charles II led them to seek refuge from it in the New World. It was among these emigrants that Presbyterianism took its organized form. In answer to a request from one of the scattered groups of Presbyterians, the Presbytery of Laggan, Ireland, sent as its missionary, Rev. Francis Makamie, in 1683. He journeyed in his missionary work as far south as the Georgias, and as far north as New York. He finally settled in Rehoboth, in eastern Maryland, where he organized the churches of Rehoboth and Snow Hill. In 1704 he returned to London, seeking aid for his work, returning in 1705, and bringing with him two additional ministers.

There was also, before the opening of the 18th century, a Presbyterian church in Philadelphia. Rev. Jedediah Andrews was its pastor, in 1701. In 1705 seven ministers, Makamie, Davis, Wilson, Andrews, Taylor, MacMish and Hampton, met by appointment in the city of Philadelphia and organized a Presbytery. It was the first Presbytery in America and the beginning of the American Presbyterian Church in its organized form. The original minutes of this Presbytery are in the archives of the Presbyterian Historical Society in Philadelphia. This Presbytery was subsequently divided into three, which were included in a Synod. The Synod held its first meeting 17 Sept. 1717, in Philadelphia. In 1741 a division occurred in the Synod resulting, not from doctrinal differences, but from those ecclesiastical passions and unregulated zeal which have so often disturbed the church. One party under the leadership of the Tennents, father and son, and greatly helped by the minister of the renowned evangelist, Whitfield, was earnestly solicitous for a revival in the church, charging it with formalism and world conformity. The other party, the conservative, resisted the charge, and sought to restrain by ecclesiastical action what they considered the immoderate zeal of the revivalists. The parties were known respectively as the New Side and the Old Side. The result of these controversies was the establishment of two independent synods, the Synod of New York, composed mainly of those favoring the New Side, and the Synod of Philadelphia, favoring the Old Side. Both synods unanimously affirmed their adherence to the Westminster Standards. This division lasted 17 years and was healed by the reunion of the two synods in 1758, under the name of the Synod of New York and Philadelphia. With the reunion came renewed effort and enlarged prosperity. Churches were organized in the Carolinas, Georgia, Kentucky, Tennessee, Virginia and Western Pennsylvania. This enlargement of the Presbyterian Church had an important bearing on the subsequent efforts of the colonies to secure their independence. The Presbyterians everywhere were foremost in resisting civil and religious oppression and when the period of the Revolution came, were unanimously in favor of independence and the establishment of a government on republican principles. Thirteen months before the signing of the Declaration of Independence, in Philadelphia, the Presbyterians of Mecklenburg County, North Carolina, had drawn up and signed a Declaration of Independence from England and also framed a system of local government. The Scotch-Irish Presbyterians in Western Pennsylvania declared for independence in May 1776. The Presbyterian element was everywhere a determining factor in the War of Independence.

In England, the rebellion was attributed especially to the Presbyterians. Walpole said in the English Parliament, «Cousin America has run off with a Presbyterian parson.» At the close of the Revolutionary War, the Synod of New York and Philadelphia met, May 1788, and revised the Confession of Faith and the Form of Government in some minor matters, which were required by the change of allegiance in civil affairs. At the same meeting it was resolved to create a General Assembly, in which all the presbyteries should be represented by their commissioners. This General Assembly held its first meeting in the Second Presbyterian Church of Philadelphia, Thursday, 22 May 1789. At this time the church had 16 presbyteries, four synods, 177 ministers and 431 churches. Among the first acts of the General Assembly was one directing that efforts should be made to send missionaries to the frontier. Before the close of the century, numerous churches had been established in the West and South. To prevent collision with the missionaries who went out from the Congregationalists in New England, the General Assembly, in 1802, entered into the Plan of Union with the associated churches of Connecticut, providing for the orderly organization of churches in mission fields. This Plan of Union continued in force until 1836, when it was abrogated by the General Assembly. It provided, in brief, that Congregational churches might settle Presbyterian ministers and the reverse; and that if a congregation was composed partly of Congregationalists and partly of Presbyterians, this fact should be no obstacle to their uniting in one church and settling a minister; and that such a church, though not presbyterially organized, should have a representative in Presbytery. Its operation led to most favorable results in the extension of the church. The opening of the 19th century was a time of widespread religious revivals. «The Great Awakening» began in Kentucky and it was attended there with some manifestations which met the disapproval of the more conservative element in the Church. In view of the great demand for ministers, some were authorized to preach who had not received a regular classical and theological education. There were also a few who held that the Confession of Faith taught fatalism. This led to the withdrawal of the Cumberland Presbytery, from which has sprung a large and influential body of Presbyterians known as the Cumberland Presbyterian Church. This separation took place 1810. (See PRESBYTERIANISM). The first quarter of the century was one of rapid growth for the Church. The tide of emigration poured westward, and new settlements and towns were founded. In all these, the missionaries of the Church found a hopeful and fruitful field for their labors. During this period, the Board of Home Missions was organized (1816). Theological Seminaries for the education of ministers were also established; Princeton (1812); Auburn (1820); Western Theological Seminary, Allegheny, Pa. (1826); Union Seminary, Virginia (1828); Columbia, South Carolina (1828); Lane (1834); Hanover, subsequently removed to New Albany, thence to Chicago and now known as McCormick Theological Seminary (1829). In 1825 appeared the beginnings of a controversy which ultimately resulted in the disruption of the Church. Various causes led to the formation of two parties, known subsequently as the Old School and the New School. Chief among these causes was the spread of New Haven Theology, or Hopkinsianism, which was supposed to be contrary to the doctrine of the Confession of Faith. It was also charged that through the Plan of Union, Presbyterian order had been subverted and that innovations in worship were permitted in certain parts of the Church. In 1836 Dr. Albert Barnes, who sympathized with the new theology, was tried for heresy before the General Assembly and acquitted. The previous year, Dr. Lyman Beecher, professor in Lane Theological Seminary, had been tried for heresy by the Presbytery of Cincinnati and ultimately acquitted. All these things produced intense excitement in the Church and widened the breach between the conservatives and the liberals. The Assembly of 1837, which met in Philadelphia, in response to a memorial signed by a large number of ministers and elders representing the Old School party, dissolved the Plan of Union with the Congregational Church, and exscinded the synods of Western Reserve, Utica, Geneva and Genesee.

At the meeting of the Assembly in Philadelphia, 1838, the commissioners from the exscinded synods presented themselves and asked to be enrolled; this being denied them, they with their friends proceeded to organize the Assembly and withdraw to hold its sessions in the First Presbyterian Church of Philadelphia. With the Old School party remained 140 commissioners, while 136 gave their adhesion to the newly organized Assembly. Thus began the unhappy division which lasted 32 years. Both Assemblies had the same name and claimed to be the General Assembly of the Presbyterian Church in the United States of America; both held to the same confession and form of government. Both Assemblies engaged zealously in the work of home and foreign missions and in the establishment of institutions of learning. Both, also, were troubled by questions concerning slavery. As early as 1787, the Presbyterian Church had declared itself in favor of the education of the slaves and for the adoption of such «prudent methods as would procure eventually the final abolition of slavery.» In 1815 the General Assembly adopted a strong antislavery document, in which it expressed regret for the existence of slavery in the United States, urged the duty of educating slaves and expressed the hope for their speedy emancipation. It further declared the buying and selling of slaves to be «inconsistent with the spirit of the Gospel.» These views were more clearly and positively avowed in the New School General Assembly than in the Old School General Assembly. In 1858, in consequence of some decided action taken with reference to slavery and emancipation, six Southern synods withdrew from the New School Assembly and constituted themselves the «United Synod of the Presbyterian Church.» In 1864 this Synod united with the General Assembly of the Presbyterian Church in the Confederate States. The passage of the «Spring Resolutions» by the General Assembly (Old School) in 1861 led to the withdrawal from that Assembly of a number of synods, all of which were within the bounds of the Southern Confederacy. This resolution was directed against the rebellion in the South and called upon all of the members of the Church to support the government in defense of the integrity of the Union. It was bitterly opposed by the commissioners from the synods in the South and by a small number from the Northern States, on the ground that in passing it the Assembly transcended its prerogatives. The objectors urged that the Assembly had no right to define civil duties. The vote on the resolution stood 156 in the affirmative and 66 in the negative. The action resulted in the withdrawal of the synods in the seceding States and the subsequent formation of the Presbyterian Church in the Confederate States of America. In 1866 the General Assembly Old School and the General Assembly New School met at the same time in Saint Louis, when steps were taken with reference to the reunion of the two bodies, by the appointment of committees to consider a plan of union. These negotiations terminated favorably and the basis of reunion, which was the Confession of Faith, after being approved by the presbyteries, was ratified by the Assembly in 1869. In May 1870, the first General Assembly of the reunited Church met in Philadelphia. In 1837, the year preceding the disruption, the ministers numbered 2,140, the churches 2,865 and the membership 220,537. At the time of the reunion, there were 4,238 ministers, 4,526 churches and 446,561 members. Since the reunion, the progress of the Church has been marked and steadfast. Two notable trials threatened for a time to disturb its peace. The first was that of Rev. David Swing, 1874, for alleged heresy with reference to the divinity of Christ. This case was settled by the withdrawal of Dr. Swing from the Church. The second was the trial of Professor Briggs of Union Theological Seminary, for his advocacy of those views of the «higher criticism» which it was claimed affected the fundamental doctrines of the Christian faith. This trial resulted in the condemnation of his views, his suspension from the ministry and his subsequent withdrawal from the Church.

Since these ecclesiastical trials the Church remains conservative, but with an increasing tendency toward liberal interpretation of standards. Though the General Assembly has repeatedly stressed the inerrancy of Scripture and has made belief in such inerrancy requisite of teachers in seminaries and candidates for the ministry, in 1902 the Assembly adopted a brief statement of the Reformed faith, not as a legal standard but as an interpretation of the Confession. It repudiated the doctrine of infant damnation, insisted on the consistency of predestination, of God's universal love, and incorporated new chapters on the Holy Spirit, the love of God and missions.

During a number of past years repeated advances have been made looking toward a union with the Southern Presbyterian Church, but so far without success. The Southern Church, while expressing the most cordial relations toward the Church of the North, has felt that the interests of Presbyterianism may be better conserved by their holding for the present to their ecclesiastical organization.

The last few decades have been remarkable in the extension of the missionary work of the Church. Up to the time of the separation between the Old and New School, the foreign mission work was carried on by the American Board of Commissioners of Foreign Missions. After the division, the Old School was established as the Board of Foreign Missions — the New School continuing as the American Board.

After the reunion in 1869 the separate Board was continued, embracing all the foreign mission work of the Church. The extent of the foreign mission activities in 1918 is indicated by the fact that the total contributions amounted to $2,131,387. The foreign missionary work is carried on in all parts of the world.

The home missionary work was carried on in early times by a committee of the General Assembly, but in 1816 the present Board of Home Missions was organized. The total home mission contributions for 1918 was $2,268,925. Its home mission work extends from Alaska to Porto Rico. The woman's home mission work was conducted as a branch of the Board of Home Missions until 1915, when it became incorporated as a separate Board. The Minutes of the General Assembly for 1918 show a roll of 9,902 ordained ministers and 9,928 churches, with a Sabbath-school membership of 1,386,928, the number of communicants being 1,631,748. Its contributions for all purposes in 1918 were $33,148,407. Other Boards caring for its other branches of Christian service are Education, Publication and Sabbath-school Work, Church Erection, Ministerial Relief, Freedmen and Temperance.

The development of the modern American life has given it within the last 15 years new fields of service in immigration, social work, city evangelization and country church work.

It has also in connection with it numerous schools, colleges, universities and theological seminaries. The national churches of Mexico and Brazil, both Presbyterian, have been established largely through its instrumentality. It has synods in India and China, and its mission operations are carried on in all parts of the world.

The Cumberland Presbyterian Church.— The origin of this branch of the Presbyterian Church is to be found in the great religious revival which swept over Kentucky and Tennessee at the beginning of the 19th century. The demand at that time for an additional number of ministers in that region led the Presbytery of Cumberland, in connection with the General Assembly, to license and ordain a number of young men of the Presbyterian Church, who had not received the required classical and theological training, for the gospel ministry. This proceeding was contrary to the rules and traditions of the Church, and was strenuously opposed by those who stood for the old ecclesiastical order. The Synod of Kentucky refused to sanction the acts of the Presbytery, and this decision was finally confirmed in part by the General Assembly. There were also among those engaged in this controversy some divergencies in doctrinal belief, especially with reference to what were claimed to be the fatalistic teachings of the Confession of Faith. The result was the withdrawal of those who were dissatisfied, and the formation of an independent presbytery, called the Presbytery of Cumberland. Those who organized it recognized as their standard of doctrine the Confession of Faith of the Presbyterian Church, but made provision for those who objected that fatalism was taught in it. The growth of this Presbytery was rapid. In three years it grew into a synod, composed of three presbyteries, and numbering 60 churches.

Its first meeting was held 5 Oct. 1813, when it proclaimed a summary of its doctrines. A year later it revised the Confession of Faith to meet its views regarding the articles to which exception had been taken. These were, specially, the third chapter with reference to the decrees of God, and the article with reference to the salvation of infants. The new Church, filled with the revival zeal of its origin, made rapid advances. In 1827 it established at Princeton, Ky., an institution of learning, with a view to securing educated men for the ministrv. In 1829 the General Assembly of the Cumberland Church was organized, consisting of five synods. At that time the field occupied by the Church embraced eight States, in which there were 18 presbyteries.

In 1906 it was adjudged that the doctrinal differences which had separated the Cumberland Church from the Presbyterian Church in the United States of America had been largely composed. A union of the two Churches was affected. At the time of the reunion the Cumberland Church had a roll of 1,514 ordained ministers serving 2,869 churches, with a total membership of 185,212 and annual contributions aggregating $933,920. A small part of the Cumberland Church, however, refused to enter into the reunion and has continued the organization of the Cumberland Presbyterian Church. The principal reason given for refusing to enter the union was that the revision of the Westminster Confession had not brought the two Churches sufficiently into doctrinal accord to justify the cessation of the separate existence of the Cumberland Presbyterian Church. The question of property and institutions was carried into the courts; but in almost all cases it was decided in the court of final appeal in favor of the body which had gone into the union. The number of ministers in the continued organization is 996 and the total number of Church membership, resident and non-resident, is 63,735. They carry on their benevolent work through Boards of Missions, Education, Publication and Ministerial Relief. They have a theological seminary — the Cumberland Presbyterian Theological Seminary — located at McKenzie, Tenn., and the Cumberland College located at Leonard, Tex. During its history, various attempts have been made to restore its union with the Presbyterian Church in the United States of America, but they failed on account of doctrinal differences until 24 May 1906 when, in convention assembled, the former at Decatur, Ill., the latter at Des Moines, Iowa, the reunion was accomplished.

The Colored Cumberland Presbyterian Church.— Prior to the Civil War the number of colored people in connection with the Cumberland Church amounted to 20,000. In times of slavery, they worshipped in the same buildings with their masters, a particular portion of the church being assigned to them; but they were not allowed to participate in the government of the church. After the Civil War, it was deemed expedient that these members should be associated in a separate organization. Accordingly presbyteries and synods were formed, which met in a General Assembly 1 May 1874. This organization, whose statistics are rather indefinite, now reports a membership of 25,000. It has one educational institution, but the poverty of the people has prevented them from obtaining a thoroughly educated ministry.

The Presbyterian Church in the United States (Southern).—This Church had its origin at the beginning of the Civil War, and from causes connected with it. The action of the General Assembly, Old School, in 1861 was one of the leading causes. By the passage of the «Spring Resolutions» concerning the Civil War, it had determined for all under its jurisdiction that their allegiance was due to the national government. A minority held that this action, whether true or false, was beyond the jurisdiction of the General Assembly, and that in making it the Church was transcending her sphere, and usurping the duties of the state, which alone had the power to define civil duties. A protest was presented against this action, in which it was urged that the Assembly in thus deciding a political question, and in making that decision binding upon those under its care, practically made a condition of church membership which violated the constitution of the Church, and usurped the prerogative of its divine Head. Presbyteries in the seceding States generally coincided with this view, and concluded that a separation from the General Assembly was demanded for the defense of a great truth, and for the protection of the liberty with which Christ had made them free. The organization of the Confederate States furnished another reason. It was, in brief, that the changed condition of civil affairs made it expedient and necessary that the presbyteries within the bounds of the Confederacy should be organized as a separate and independent body. Accordingly 93 ministers and elders, representatives from presbyteries, met in Augusta, Ga., 4 Dec. 1861, and constituted a General Assembly, under the name of the General Assembly of the Confederate States of America. They adopted at the same time, as their standards of doctrine, the Westminster Confession of Faith, and the Form of Government as held in the old Church. At the close of the war, the name of the Church was changed to the Presbyterian Church in the United States. In 1864 the United Synod of the South, composed of the presbyteries and churches which had seceded from the General Assembly (New School), on account of its action concerning slavery, was admitted into the General Assembly of the Confederate States. It consisted of 120 ministers, 190 churches and 12,000 communicants. In 1869 that portion of the Synod of Kentucky which had separated from the General Assembly (Old School) in 1867 was received into connection with the Southern General Assembly, bringing with it 13,540 communicants. In 1874 the independent Synod of Missouri, which had separated itself from the Northern Assembly on account of its action concerning civil affairs, united with the Southern Assembly. The churches in connection with this Assembly are almost exclusively in what is known as the Southern States, and for that reason it is commonly called «the Southern General Assembly» in distinction from the Assembly, North. Its missionary and benevolent operations are not conducted by organized boards, but through committees elected annually by the General Assembly, directly responsible to it, and acting under its instruction. It carries on mission work in China, Africa, South America, Greece, Italy and Mexico. Its home mission work is conducted with vigor and efficiency, and includes work among Indians and negroes, as well as the white population. It has under its care Union Theological Seminary at Richmond, Va.; the Theological Seminary at Columbia, S. C., and the Theological Seminary at Louisville, Ky. The last-named institution, having been joined with Danville Seminary, is now under the joint control of both synods of Kentucky, one in connection with the Northern and the other with the Southern Assembly.

In addition to these, the Southwestern Presbyterian University at Clarksville, Tenn., has a theological department, and there is also a theological seminary at Austin, Tex. For the education of the colored ministry there is the Stillman Institute at Tuscaloosa, Ala., making a total of six theological seminaries. This branch of the Church, while holding in common with other Presbyterian churches the Westminster Confession and Cathechisms, Larger and Shorter, lays special emphasis upon the spirituality of the Church in its functions. It insists that church courts shall be governed by the articles of the Confession, which says, «synods and councils are to handle or conclude nothing but that which is ecclesiastical.»

The latest statistics for this Church are as follows: Number of ministers, 1,861; number of communicants, 348,223; number of Sunday-school pupils, 328,252; and total contributions, $4,967,852.

The United Presbyterian Church of North America.— This organization is the result of a union between the Synod of the Associate Reformed Church and the Associate Synod, commonly known as the Seceders. This union took place in Pittsburgh 26 May 1858. The basis of it was the Westminster Confession of Faith, with a modification of the chapter on the power of the civil magistrate, the Catechisms, Larger and Shorter, and a Judicial Testimony. Most of the articles in this testimony are held in common by all Evangelical churches, but there are five which are special to this denomination. The first declares that slave holding is a violation of the law of God and contrary both to the letter and spirit of Christianity. The second declares that all secret and oath-bound societies are inconsistent with the genius and spirit of Christianity, and that church members ought not to have fellowship with such associations. The third is a declaration in favor of close communion; none are to be admitted to the sealing ordinances of the Church except such as give their assent to its doctrines. The fourth declares the duty of public social covenanting at special times. The fifth affirms that it is the will of God that the songs contained in the Book of Psalms should be used exclusively in public worship, and that hymns, the composition of uninspired men, should not be employed in such service. In all other respects, the laws, government and discipline of this Church are the same as those of other branches of the Presbyterian Church. It has been distinguished for the careful training of its ministry. It has in its connection two theological seminaries and six colleges. For the execution of its work the United Presbyterian Church has seven boards, namely: Home, Foreign, Freedmen's Mission, Church Erection, Publication, Education and Ministerial Relief.

Its foreign mission work is now carried on in India, Egypt and the Soudan. In home missions it has been progressive in work in the mountains of the South, among the foreigners and the Mormons and the freedmen of the South. It also has departments of work in Bible schools, evangelism, social service and industrial conditions. The latest statistics give 1,143 ordained ministers and 1,150 congregations. The communicants in America are 156,954. The total membership, including the foreign field, is 200,879. Its contributions in 1916 were $3,006,508.

The Reformed Church in the United States (German Reformed).— Previous to the Revolutionary War a considerable number of emigrants from the Palatinate, a district of Germany, emigrated to America and settled in Pennsylvania. They were members of the Reformed Church in Germany and were men of sterling character and devoted piety. They became important factors in the settlement of middle and western Pennsylvania, and also took part in the Revolutionary War. The first German Reformed minister settled among these emigrants was Philip Boehm, who came to America in 1720. In 1747 there were five ordained ministers and 46 organized churches. In 1793, at which time the Synod was divided into classes, there were 22 ordained ministers and about 150 churches. Subsequently affiliated synods were organized in Ohio and in the neighboring States; but it was not until the year 1863 that organic union was established between them. The General Synod was organized 18 Nov. 1863 in Pittsburgh, Pa. It holds its sessions triennially. It is a delegated body composed of an equal number of ministers and elders, elected by the several classes, constituting eight synods. The General Synod has under its control the various boards to which are entrusted the work of home and foreign missions, and also that of the Sunday school. The membership of the Church is located in the northern belt of the country extending from the New England States to the Pacific slope and southward as far as North Carolina.

The last statistics give the number of ministers as 1,245 and of congregations 1,773, with a communicant list of 326,112 members. Their gifts for benevolence during 1916 were $687,446. Its principal foreign mission work is in China and Japan, where evangelistic, educational and hospital work is conducted. It conducts a growing home mission work at an expense last year of $162,349.

The Reformed Presbyterian Church in North America.— This organization traces its ancestry to the Covenanters and claims to be a lineal descendant of the Kirk of Scotland. Its name has a twofold significance and is a résumé of its history. It is called Reformed, to indicate that it was founded on the principles of the Reformation, and Presbyterian because of its adoption of and long struggle to maintain that form of government. The first presbytery of the Reformed Presbyterian Church in America was organized in 1774. In 1782 the majority of this presbytery united with the Associate presbyteries and formed the Associate Reformed Church. A few refused to accept the union and maintained their organization in what was called "praying circles." Ministers having been obtained from Scotland, in 1798 the presbytery was again constituted. In 1809 the Synod of the Reformed Church was organized with three presbyteries, in Philadelphia; through the increase of churches and presbyteries a General Synod was in time organized. But in 1833 a division occurred by which it was separated into two branches, known respectively as the Synod of the Reformed Church and the General Synod of the Reformed Church. The distinctive features of the Reformed Church are, first, the kingly office of Christ in the sense that nations as well as individuals are his subjects and should acknowledge his authority. Hence Reformed Presbyterians "decline to hold office or to exercise the right of suffrage in any government that does not clearly own Christ as king and his law as supreme." Second, the exclusive use of the Psalms in praise. Third, opposition to secret and oath-bound societies. Fourth, communion restricted to church membership. The cause of the division of the Synod into two branches was a difference of opinion concerning the application of these distinctive principles, one party demanding a rigid and the other a liberal interpretation.

The Synod maintained that voting under the Constitution of the United States involves immorality. The General Synod maintained that voting does not involve morality, a position that makes it so near like several other American denominations as to dim its individuality. The General Synod has 20 ministers, 17 congregations and about 3,000 communicants. The Synod of the Reformed Church, representing the "Old Side," is the stronger of the two branches. It now has 8,481 communicants.

The Christian Reformed Church.— The organization of this Church took place in 1857. It is lineally descended from the Reformed Church of Holland. About the year 1847 a large number of Hollanders, connected with the Christian Reformed Church of the Netherlands, emigrated to America and settled in Michigan. For a short time they became associated with the Dutch Reformed Church, now the Reformed Church of America; but after a time withdrew on account of what they deemed laxity in doctrine and discipline, and formed an organization of their own. Its membership is to be found mainly in the States of Michigan, Illinois, Iowa and New Jersey, with a few scattered congregations in New York, Ohio, Indiana, Wisconsin and Minnesota. It is rigidly Calvinistic in its doctrines, accepting as its standard the articles of the Synod of Dort, and the Heidelberg Catechism. It is opposed to secret oath-bound societies and uses almost exclusively the Psalms in the service of praise. It uses also a liturgy in the administration of the sacraments and in the ordination of ministers and elders. Its theological school is in Grand Rapids, Mich. It numbers about 160 churches and 36,296 communicants. Its General Synod meets biennially at Grand Rapids, Mich. Its ministers officiate in the English, German, French, Bohemian and Hungarian languages.

The Welsh Calvinistic Methodist.— This branch of the Presbyterian body is derived from the Calvinistic Methodist Church of Wales. The first church of this denomination in the United States was organized in Remsen, N. Y., and three years later the first presbytery was constituted. On 22 Sept. 1869 the General Assembly was organized and held its sessions in Columbus, Ohio; and it has met triennially ever since. Its standards of doctrine are the same as those of the parent church in Wales. Its system of government is presbyterian. The Church exists among the Welsh in 13 States of the republic, and in 1916 had 14,326 members.

The Associate Reformed Synod of the South.— The origin of this synod dates back to the year 1821. It was the result of a secession from the Associated Reformed Church on account of differences concerning psalmody and communion questions. Its membership is confined principally to the Southern States and numbers about 15,112. Its doctrinal symbols are the same as those of other Reformed churches.

There are also in the United States several organizations of Presbyterians known respectively as The Associate Church of North America, The Reformed (Covenanted) and The Reformed in the United States and Canada. The number of their adherents is small, not exceeding 2,000.

Presbyterian Churches in Canada.— Presbyterianism in Canada is of Scottish origin, and in it are to be found representatives of every shade of Presbyterianism that has appeared in the British islands. Its early history is marked by divisions, which in course of time have been overcome. In 1831 the Synod of the Presbyterian Church of Canada, in connection with the Church of Scotland, was organized. Meanwhile other Presbyterian ministers, chiefly of the Associate Church of Scotland, organized themselves as the United Synod of Upper Canada. These two bodies were united in 1840. Previous to this union another church had been formed under the name of the United Presbyterian Church of Canada. On 10 July 1844, 25 ministers, in connection with the Church of Scotland, who were in sympathy with the Free Church movement in Scotland, withdrew from the Synod and constituted themselves a separate body, under the name of the Presbyterian Church of Canada. For 17 years these three bodies maintained a separate existence; but in 1861 a union was effected between the United Presbyteries and the representatives of the Free Church, under the name of the Synod of the Canada Presbyterian Church. This synod entered upon a prosperous career, and in 1870 the supreme court of this Church was for the first time constituted as a General Assembly. In 1866 a union was accomplished between the churches of Nova Scotia and New Brunswick; and in 1868 the synods of Nova Scotia and New Brunswick, in connection with the Church of Scotland, formed one synod. A general union of all the churches took place in the year 1875, into which union, under the name of the Presbyterian Church of Canada, came the Presbyterian Church in Canada, in connection with the Church of Scotland, the Canada Presbyterian Church, the Church of the Lower Provinces and the Church of the Maritime Provinces in connection with the Church of Scotland. This union was cordial, and it has been followed by marked progress and substantial prosperity. The united Church has 1,899 ministers, 1,675 congregations and 333,457 communicants. The total contributions for all purposes in 1916 amounted to $5,460,133. The home mission work is comprehensive, embracing such fields as evangelism, moral and social reform, congested city districts, church and rural life and church and industrial life. It is carrying on foreign missions. The 182 missionaries are engaged in China, Korea and India. It has five theological seminaries. See PRESBYTERIANISM.

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PRESBYTERIAN COLLEGE BOARD, an organization formed by the General Assembly in 1883, for the purpose of establishing colleges for the education of ministers, especially in the sparsely-settled Western States. Colleges must be of professed Christian purpose and desirous of converting all students under their tutelage in order to receive assistance. Fifty-one colleges are now co-operating with this board. See PRESBYTERIAN CHURCH.

PRESBYTERIAN COLLEGE OF SOUTH CAROLINA, a South Presbyterian institution of learning at Clinton, S. C., founded in 1880. The faculty numbers 10; the average annual enrolment of students is 120. The library contains over 3,000 volumes.

PRESBYTERIAN SYSTEM, Alliance of the Reformed Churches Throughout the World Holding the. Previous to 1870 the desire had been frequently expressed that the various branches of the Presbyterian churches could be united in some general alliance which would express the generic unity of Presbyterianism. Some attempts had been made in this direction, but the first official step in this country was taken by the General Assembly of the Presbyterian Church, U. S. A., at its sessions in Baltimore 1873. As a result of this action, the alliance was formed by representatives from different Presbyterian churches in London, England, in the year 1875. The alliance is composed of representatives from different branches of the Presbyterian Church throughout the world. The action of its General Council is not legally binding upon any of the churches, but only advisory in its character. It has, however, been enabled through its counsels to regulate the mission work of the Church, and to bring different branches of the

Presbyterian family into closer relations, for mutual support. The alliance has held seven General Councils: the first was in Edinburgh, Scotland, 1877; the second in Philadelphia, U. S. A., 1880; the third, in Belfast, Ireland, 1884; the fourth in London, England, 1888; the fifth in Toronto, Canada, 1892; the sixth in Glasgow, Scotland, 1896; the seventh in Washington, D. C., 1899; the eighth in Liverpool, England, 1904. The churches connected with the alliance number more than 90, and are located in all parts of the world. The adherents of the Presbyterian and Reformed churches represented in the alliance number at the present time about 30,000,000.

PRESBYTERIANISM, a term derived from the Greek word πρεσβύτερος, meaning «an elder,» defines, primarily, a system of church government. As such, it stands midway between Episcopacy or Prelacy and Independency or Congregationalism. It affirms that the Church, as to its government, is a theocracy under law to Christ, its supreme and only Head and Lawgiver; but the powers of government are vested in the body of believers, and are to be exercised through their chosen representatives called «elders.» It denies the claim of one man, or of a special class of men, to rule the Church by virtue of a divine right. In opposition to papacy and prelacy, it asserts the right of the Church to govern itself through its chosen representatives, administering rule and discipline according to the word of God. «The radical principles of Presbyterian Church government and discipline are: that the several different congregations of believers, taken collectively, constitute one church of Christ, called emphatically, The Church;— that a larger part of the church or a representation of it, should govern a smaller, or determine matters of controversy which arise therein; that in like manner a representation of the whole should govern and determine in regard to every part, and to all the parts united; that is, that a majority shall govern; and, consequently, that appeals may be carried from lower to higher judiciaries, till they be finally decided by the collected wisdom and united voice of the whole church. For these principles and this procedure, the example of the Apostles and the practice of the primitive Church are considered as authority.»

The Presbyterian form of government is essentially republican. It differs from Congregationalism in that it asserts the visible organic unity of the Church in the sense that all local or individual churches are included under one government, in which the majority governs. In accordance with its representative form of government, it has a succession of church courts or judicatories. First in order is the session, or consistory, of the local church, chosen by its members. Next is the presbytery, having jurisdiction over the ministers and churches within a certain limited district. It is composed of the ministers, and one elder from each church in the district. The synod, likewise a representative body, has jurisdiction over the presbyteries; and there must be at least three presbyteries to compose a synod. The boundaries of synods in America are usually, and for the sake of convenience, coterminous with the boundaries of the States in which they are located.

The highest court is called the General Assembly, or General Synod. It is a representative body, composed of an equal number of ministers and elders elected by the presbyteries. The number of representatives from each presbytery varies according to the membership of the presbytery; but each presbytery is entitled to be represented by one minister and one ruling elder. The General Assembly represents all the churches under its care. It exercises administrative, legislative and judicial powers, and its decisions are final and binding upon all the lower courts, when made in accordance with the constitution of the Church. Another characteristic of Presbyterianism is the parity or equality of the ministry. According to its teachings, there are but two permanent official orders in the Church, bishops or elders and deacons. The first includes both teaching and ruling elders. The term deacon includes the two-fold distinction of male and female. The deacons are those to whom is especially committed the administration of the charities of the Church (Acts vi, 3).

Presbyterians claim for their order and form of government apostolic and scriptural sanction. Some among them have gone so far as to assert that the Presbvterian form of government is *jus divinum*, and that none other can be allowed in the Church. This extreme position, however, has had but very few advocates. The general view is, that it is an ancient form of government having apostolic sanction, and that it is agreeable to Holy Scripture. The main argument by which this view is supported is in brief this: The office of elder was established in the Old Testament Church in the earliest time. The elders were a distinct class of office bearers in the Hebrew commonwealth, and ruled in the synagogue or local church. In biblical history they are mentioned as representatives of the people (Exodus iii, 16 and iv, 24; 1 Samuel viii, 4; 2 Samuel v, 3; 1 Kings viii, 1). They were especially prominent in the synagogue worship, familiar to the Jews from the time of the return from the Babylonian captivity. Each synagogue had a bench of elders, with a presiding officer known as the «chief ruler,» to which was entrusted the oversight of the congregation. The «rulers» of the synagogue, mentioned in the gospel narrative, were these elders. The government of the synagogue, with its system of appellate courts terminating in the Sanhedrin, was Presbyterian (Edersheim, ‹Life of Christ,› Vol. II, p. 552). Jesus Christ and His chosen apostles, the founders of the Christian Church, had been trained in the synagogue and were accustomed to no other form of church government. They knew that it had been previously sanctioned by prophets, priests and kings, all through the history of the chosen people. It was but natural that the same form of government should be adopted in the new church or «Ecclesia,» the body of those «called out» from the synagogue.

That the synagogue furnished the model for the government of the Christian Church is confirmed by the statements of the apostles. Acts xiv, 23 and xx, 17–18; 1 Peter v, 1; 1 Timothy iv, 14 and v, 17. It is further claimed that the terms *episcopos* and *presbyteros*, signifying respectively bishop and elder, are equivalent terms designating the same office. Elders and deacons constituted the office bearers of the early Church. In course of time the “chief ruler” came to be known as *episcopos,* the bishop of the church; but each church had its own bishop or overseer. They were what the Presbyterian pastor is at the present time. Such in general are the grounds upon which Presbyterians claim that their form of government is both primitive, apostolic and conformed to the New Testament Church order. Whatever may have been the primitive form of church government in the Christian Church, it is a historical fact that from the 3d century what is known as prelacy became the prevailing order, culminating in the papacy. At the time of the Reformation (1692–1700) all the reformers desired to restore to the people their primitive rights, but there was considerable diversity of opinion as to methods. John Calvin, in Geneva, was the first to organize a representative government in a practical form, by restoring the eldership to the church.

His conception of the eldership was adopted in the Reformed churches of Scotland, France, Holland and practically in Germany. It was through the struggle to maintain a representative form of government, as against the claims of prelacy, that the term “Presbyterian” was applied to the churches holding that form of government. The Church of Scotland and the Reformed churches of France and Holland are Presbyterian as to their form of government. Most of the Reformed churches have adopted, with slight modifications, the Presbyterian polity. The Methodist Episcopal Church in America, the largest of the Protestant bodies, while Episcopal in name, has become Presbyterian in fact, so far as polity is concerned. In the Protestant Episcopal Church there is now representation from the laity, and the powers of the presbyters have been greatly enlarged. The Lutheran Church in the United States is also presbyterian in policy.

The Doctrines of the Presbyterian Church. — While the term “Presbyterian” defines, primarily, a polity or form of church government, it is also definitive of a system of doctrine, known as the Calvinistic or Reformed. So far as doctrine is concerned, Presbyterianism and Calvinism are synonymous. It is a popular mistake to suppose that Presbyterians accept all the teachings of the great Genevan reformer, John Calvin; but his statement of the Pauline or Augustinian system of theology is generally accepted by all branches of the Presbyterian family, and is embodied substantially in their Confessions. The five distinguishing features of the Calvinistic doctrine are: the absolute sovereignty of God in creation, providence and redemption; the fall of man and his utter inability to save himself from the consequences of his transgression; the election from this fallen race by the sovereign grace of God of a certain number unto eternal life; the provision made for their salvation in Jesus Christ; their effectual calling by the Holy Spirit; and their perseverance in divine grace, assured by the indwelling of the Holy Spirit.

The accepted symbols of the Presbyterian faith are, the Canons of the Synod of Dort, 1619 A.D., the Westminster Confession of Faith with the Catechisms, Larger and Shorter, 1648 A.D., and the Heidelberg Catechism, 1563 A.D. (See Dort, Synod of, and Westminster Assembly). These symbols are regarded as subordinate standards. Presbyterians receive the Scriptures of the Old and New Testament as the supreme standard, “the only infallible rule of faith and practice.” In America, the most widely accepted symbol of faith is the Westminster Confession, slightly modified from its original form. In the year 1900 a movement was inaugurated in the largest denomination of the Presbyterian Church for a revision of the Confession of Faith. This movement resulted in the adoption in the year 1903 of an explanatory statement with reference to the third chapter of the Confession of Faith, and in sundry minor amendments. The Assembly also adopted a Brief Statement of Doctrine to be used in the churches under its care. The Confession of Faith as revised still remains the authoritative standard of the Church. Ministers and office bearers are required to subscribe to it in the following terms: “Do you sincerely receive and adopt the Confession of Faith of this Church as containing the system of doctrine taught in the Holy Scriptures?” But the only requirement for admission to the communion of the Presbyterian Church is faith in the Lord Jesus Christ, as the divine Saviour of men.

While claiming that their polity is lawful and agreeable to the Word of God, and that their system of doctrine is that taught in Holy Scripture, Presbyterians recognize all other churches holding to the essential doctrines of Christianity as parts of the one Catholic Church.

History of the Presbyterian Church.—The history of Presbyterianism begins with the reorganization of the Church in the Reformation period, at a council held in Zürich, 26 Oct. 1523, at which the principles of primitive Presbyterianism were formally adopted, and thereafter became the distinctive features of the Reformed churches in Switzerland, France, Belgium, Holland and Prussia. They were adopted by the Church of Scotland which, under the leadership of John Knox, separated herself from the papacy. They were also introduced into England about 1572 by Cartwright. In Scotland, and in the north of Ireland, Presbyterianism has continued to be the dominant faith; and from these great centres it has exerted an influence extending throughout the world.

The Church of Scotland.— Presbyterianism in Scotland is divided into different branches, chief of which is the Church of Scotland, commonly known as the Established Church. It is the state church, supported by the government. It was organized in 1560 and legally established in 1592 by the Scottish Parliament. It is, numerically, the largest Church in Scotland, and its various enterprises, which are many and important, are carried on with great energy and liberality. According to the statistics of 1916 the Church of Scotland has 718,719 communicants.

The Free Church of Scotland.— This branch of Presbyterianism originated in a separation from the Established Church in the year 1843. The immediate cause of the disruption was diversity of views on the subject of patronage. One of the principles of Presbyterian government is, that “no minister should be intruded upon a congregation contrary to its will.” By act of Parliament, the right to appoint ministers to vacant churches had been conferred on certain landed proprietors connected with the parishes. The General Assembly for many years protested against this enactment, but to no avail. The exercise of this legal right in a particular case led ultimately to the withdrawal of a large number of ministers and churches from the establishment, and to the organization of the Free Church of Scotland. But the great underlying reason for this movement was, the determination to maintain the spiritual independence of the Church from the civil power, and her liberty to obey the Lord Jesus Christ as the Supreme Head of the Church. The new organization grew rapidly and took a foremost place in missionary and educational work.

The United Presbyterian Church of Scotland.— This organization originated 13 May 1847 in a union between the United Secession and the Relief Churches. These churches had originated from doctrinal differences in the past, and the harsh exercise of discipline in the establishment. The United Church has been distinguished for its missionary zeal and progressive spirit. It has been said of it, that it has done more for the diffusion of the gospel throughout the world than any other denomination of its size, except the Moravians.

As early as 1862 negotiations for a union of this branch of the Church with the Free Church were begun, and they were continued from time to time till 1873 without any manifest results. In 1896 the United Presbyterian Church again took up the matter of union with the sister body, and the following year the Free Church responded by appointing a committee of conference. The United Presbyterian Church did the same and a remarkable and happy agreement was discovered between these two bodies both as to doctrinal standards and their methods of work. A common constitution was adopted and in 1900 the way for a complete union was open. The general assemblies of the two bodies met in their respective places on the thirtieth of October and the next day the «United Free Church» was constituted and entered upon its career. The small body claiming for themselves the title of the «Free Church of Scotland» resisted the union and the contest for the property was carried through various courts and up to Parliament, with the final decision which deprived the «United Free Church» of all the property of the original Free Church and left it in the control of the very small body claiming to be the «Free Church of Scotland.» That body in 1901 had only 25 ministers and 63 congregations. They were largely the churches of the Highlanders and protested against all relaxation in the terms of subscription, against the disestablishment of the Church, against the use of hymns and organs, against the toleration of Glasgow professors in their chairs.

While the general decision of the highest court remained, final arrangements for the use of the property of the «United Free Church» were made, by which, in cases where the «Free Church» could not use or occupy, it might go to the United body. Under the decision of the appointed commissioners the Assembly Hall with new college buildings and the High Church were to be the property of the «United Free Church.» The allocation of the churches from the one body to the other has been slow, but in 1908 over 100 churches had been assigned to the use of the «United Free Church.» That body now carries on missions in India, Manchuria, Africa, Melanesia and in the West Indies. It has three divinity halls at Glasgow, Aberdeen and Edinburgh, is progressive in all its educational and missionary work. By the latest available statistics the «United Free Church» has 512,000 communicants.

The Presbyterian Church of England.— Presbyterianism in England is associated with the great Puritan movement in that country. It manifested itself in the famous Westminster Assembly, 1643. When prelacy was abolished by the Long Parliament, Presbyterianism was established in its stead, 29 June 1647, and for 20 years it was the national church of England. But opposed by Cromwell and Independency, on the one side, and by the Episcopal Church on the other, it was destined to lose its position. After the restoration of Charles II, and on Saint Bartholomew's Day, it was disestablished and 2,000 ministers, most of them Presbyterian, were ejected from their parishes. In 1686 Presbyterianism was, by act of Parliament, denied civil and religious rights. The passing years brought some amelioration, as a more tolerant spirit pervaded legislation; but from that time until 1850 it had only a feeble existence. Since the latter date, through the union of various scattered churches, Presbyterianism has greatly revived in England.

Thus, in 1876, the English congregations of the United Presbyterian Church of Scotland, which was strong in the three districts of Northumberland, Lancashire and London, were gathered into one synod with the Church of England and known as the Presbyterian Church of England. In 1897 it founded the Westminster College at Cambridge for the purpose of securing a home-bred ministry for its churches. In recent years there has been some revision of its standards but without setting aside its Westminster Confession. Twenty-four Articles of Faith have been adopted. In these, however, there is no essential change of doctrine, but rather of emphasis. According to the statistics of 1916, the Presbyterian Church in England and Wales numbers 88,166.

Welsh Calvinistic Methodist (Presbyterian).— This Church represents Presbyterianism in Wales. The movement which resulted in the establishment of this Church began in 1736 and owes its origin to the evangelical revivals which were spreading throughout the country at that time. In 1864, the two synods, that of North Wales and that of South Wales, united in one General Assembly, whose decisions are binding upon churches in all matters of controversy between them. This Church maintains cordial fellowship with the Presbyterian Church of England. Its Confession of Faith in all essential articles is in harmony with the Westminster Confession, and with the Thirty-Nine Articles of the Church of England. Its leading theological seminary is at Bala, North Wales. It has also under its care a college at Trevecca, South Wales. It has both Home and Foreign Missionary societies, and a fund for the support of aged and infirm ministers. The above-named churches are the principal branches of the Presbyterian Church in the United Kingdom of Great Britain. In addition to these there are in Scotland the Reformed Presbyterian Church, and the original Secession Church of Scotland, with a combined membership of about 10,000, and in England a branch of the Church of Scotland.

The Irish Presbyterian Church.— Presbyterian ministers began their work in Ireland as early as 1594, but on account of persecution Presbyterianism did not obtain a permanent footing there until 1642. It found its home in the northern part of the island, and in the province of Ulster. Its progress was at first hindered by divisions, and by the presence of Arianism which was openly avowed by some of its ministers. In 1840 the various churches were united in one body under the name of the General Assembly of the Presbyterian Church in Ireland. Since this union the Irish Presbyterian Church has occupied a commanding position in the country. It has at present more than half a million people under its care, 560 congregations, over 600 ministers, 5 synods and 37 presbyteries. For a time its ministers were supported by the *Regium Donum* — a grant from the state. About 33 years ago this grant was commuted into a general fund amounting to $3,000,000. This is the basis of the Sustentation Fund, the income from which, increased by voluntary contributions from the churches, supports the ministry. The Church has large foreign missions, and has under its care the Assembly's College at Belfast, and the Magee College, Londonderry. For the last 150 years there has been a constant stream of emigration from the north of Ireland to America and the British colonies, so that the Irish Presbyterian Church has been largely instrumental in establishing Presbyterianism in other parts of the world. Three small communities in Ireland have failed to go into the United Irish Presbyterian Church and retain their separate autonomy under the names of the Reformed Presbyterian Church, the Eastern Reformed Church and the Secession Church.

Presbyterian Churches in Europe.— The Reformed churches of the Reformation period in Switzerland, France, Germany, Bohemia and the Netherlands were generally presbyterian as to their form of government. In addition to these is the ancient church of the Waldensians, dating from primitive times and now established in various parts of Italy and Switzerland. In later years the Presbyterian Church has been extended to Spain, Hungary, Austria, Russia and Norway. The number of adherents in Europe is somewht over 14,000,000.

There are also scattered groups of Presbyterians in Africa, Asia, Australasia and South America, numbering all told about 2,600,000.

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For the Churches of England: McCrie, ‹Annals of English Presbytery›; Skeats, ‹History of Free Churches in England›; Brook, ‹Life of Thomas Cartwright›; Grosart, ‹Representative Noncontormists.›

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CHARLES L. THOMPSON, D.D.,
Ex-Moderator, Presbyterian Assembly.

PRESBYTERY, in Presbyterian churches, a court of judicature consisting of all the ministers of the denomination within a given district, and of ruling elders, one from each church session. Each meeting is opened with prayer by the moderator. The functions of the court are purely executive, not legislative. It has supervision of all the congregations within its territorial limits, hears appeals from decisions of the several sessions, examines candidates for the ministry, issues licenses to probationers, ordains ministers, and in general guards the spiritual interests of the congregations under its charge in matters of doctrine or of discipline.

PRESCOTT, Albert Benjamin, American chemist: b. Hastings, N. Y., 12 Dec. 1832; d. 1905. He took his M.D. at the University of Michigan in 1864 and in 1864–65 was assistant surgeon of the United States volunteers. He was appointed assistant professor of chemistry at the University of Michigan in 1865, where he subsequently became professor of organic and applied chemistry in 1870, dean of pharmacy in 1876 and director of the chemical laboratory in 1884. He was president of the American Association for the Advancement of Science in 1891, and of the American Pharmaceutical Association in 1900. Author of ‹Qualitative Chemical Analysis› (1874; 5th ed., 1901); ‹Chemistry of Alcoholic Liquors› (1875); ‹Nostrums in Relation to the Public Health› (1881); ‹Manual of Organic Analysis› (1888), etc.

PRESCOTT, George Bartlett, American electrician: b. Kingston, N. H., 16 Sept. 1830; d. New York, 18 Jan. 1894. He studied electricity and telegraphy and from 1847–58 was manager of several telegraph offices in Connecticut and Massachusetts, becoming in the latter year superintendent of the American Telegraph Company and in 1866 accepted the same position with the Western Union Company. He was electrician of the International Ocean Telegraph Company in 1873–80, was actively interested in various telephone and telegraph companies and was one of the promoters of the former. He discovered the electrical origin of aurora borealis in 1852, invented several improvements in telegraph and telephone instruments, was engaged with Edison in the invention of the duplex and the quadruplex telegraph which he successfully launched on the market and introduced in this country the European system of dispatching messages through pneumatic tubes. He published in the *Boston Journal* and in the *Atlantic Monthly* accounts of his discoveries concerning the aurora borealis and also wrote ‹History, Theory and Practice of the Electric Telegraph› (Boston 1860); ‹Electricity and the Electric Telegraph› (New York 1879); ‹The Speaking Telephone, Electric Light and Other Recent Electrical Inventions› (New York 1879); ‹Dynamo-Electricity; Its Generation, Application, Transmission, Storage and Measurement› (New York 1884); ‹Bell's

Electric Speaking Telephone: Its Invention, Construction, Application, Modification and History’ (New York 1884).

PRESCOTT, Oliver, American soldier: b. Groton, Mass., 27 April 1731; d. there, 17 Nov. 1804. He was a brother of Col. Wm. Prescott (q.v.). He was graduated from Harvard in 1750 and engaged in the practice of medicine, becoming one of the most successful and popular general practitioners. He was a charter member of the Massachusetts Medical Society, incorporated in 1781. In 1780 he became a Fellow of the American Academy of Arts. He was also for many years one of the trustees of Groton Academy. He was an officer in the State militia with rank as major, lieutenant-colonel and in 1776 became a brigadier-general and a member of the board of war. In 1777 he was elected to the supreme executive council of his State and in 1778 received rank as third major-general of militia. He resigned soon after his promotion to second major-general in 1781 and was empowered by the government to cause the arrest of any person whom he should consider dangerous to the Commonwealth. In 1779 he was made judge of the Probate Court of Middlesex County, Mass., and played an important part in the suppression of Shay's rebellion in 1786–87. Consult Prescott, W., M.D., ‘The Prescott Memorial’ (Boston 1870).

PRESCOTT, William, American soldier, brother of O. Prescott (q.v.): b. Groton, Mass., 20 Feb. 1726; d. Pepperell, Mass., 13 Oct. 1795. He served with the rank of lieutenant in the expedition against Nova Scotia under Wilson in 1755 and was offered a commission in the British army. He declined the honor and lived in retirement until the battle of Lexington in 1775 when he joined the Continental camp at Cambridge with a regiment which he had organized in 1774 and of which he was colonel. At the battle of Bunker Hill he was very conspicuous, really commanding the patriot forces and displaying the greatest courage and ability. He served in the Continental army until the end of 1776 and then retired from active duty with the exception of a short service as a volunteer at Saratoga in 1777. After his retirement from the army he served as town clerk and selectman of Groton and for three years represented his town in the General Court of Massachusetts. For the balance of his life he was an acting magistrate. Consult Gardner, F. A., ‘Colonel William Prescott's Regiment’ (in *Massachusetts Magazine*, Vol I, pp. 149 and 235, Salem 1908); Green, S. A., ‘Colonel William Prescott and Groton Soldiers in the Battle of Bunker Hill’ (Cambridge, Mass., 1909); Parker, F. J., ‘Colonel William Prescott, the Commander in the Battle of Bunker Hill’ (Boston 1875); Prescott, William, M.D., ‘The Prescott Memorial’ (Boston 1870).

PRESCOTT, William Hickling, American historian: b. Salem, Mass., 4 May 1796; d. Boston, 28 Jan. 1859. In 1811 he entered Harvard College and was graduated in 1814. He long had trouble with his eyesight which eventually became so weak that during the latter half of his life he could read only for a few moments at a time, and could scarcely see to write at all. He had early resolved to devote himself to a literary life and soon after leaving college went to Europe and spent two years in traveling through England, France and Italy. The subject for which his inclination and abilities more especially fitted him was history and he published his ‘History of the Reign of Ferdinand and Isabella the Catholic’ in three volumes in 1837 in Boston. The success which this achieved was most decisive. It was received with the utmost enthusiasm both in America and Europe; was soon translated into French, Spanish and German; and its author was elected a member of the Royal Academy of History of Madrid. Prescott's next work was the ‘History of the Conquest of Mexico, with a Preliminary View of the Ancient Mexican Civilization and the Life of the Conqueror Hernando Cortez’ (3 vols., New York 1843), which was received with equal favor; and next appeared the ‘History of the Conquest of Peru, with a Preliminary View of the Civilization of the Incas’ (3 vols., New York 1847). Prescott now began the ‘History of the Reign of Philip II.,’ and no pains nor expense were spared by him to render the result commensurate with the undertaking. He received the most liberal co-operation from all quarters, public and private, and everywhere both public and private collections were thrown open to his inspection. In 1855 the first two volumes of the work appeared entitled, ‘The History of the Reign of Philip II, King of Spain,’ and in 1858 the third volume. In 1857 Prescott published an edition of Robertson's ‘History of the Reign of Charles V,’ with notes and supplement, containing an account of the emperor's life after his abdication.

The labors of Prescott afford a remarkable instance of the success of indomitable industry and perseverance carried out in the face of what might otherwise appear almost insurmountable obstacles. Partial blindness preventing him from consulting personally the authorities from which he drew his materials, he had them read aloud to him. His first reader knew, however, no language but English. The historian “taught him,” as he says, “to pronounce the Castilian, suited, I suspect, much more to my ear than to that of a Spaniard.” He afterward obtained the services of a reader acquainted with several of the Continental languages. Prescott's contemporaries laid strong emphasis and not unjustly, on the thoroughness of his research. But unfortunately modern discovery had done much to correct his pictures of early American civilization, for his information on which he had no recourse save the Spanish chroniclers. Hence ‘The Conquest of Mexico’ and ‘The Conquest of Peru’ are now to be valued less for their historical accuracy than for the sweep of the narrative and unfailing interest of the style. Indeed, this “easy flow of language” and “faultless lucidity,” praised by Bancroft, is everywhere apparent in Prescott's work. He has not escaped the charge of too highly coloring his scenes for the sake of dramatic effect. He was not an analytical investigator, but rested content with a splendid synthetic arrangement of the concrete facts which he sincerely labored to obtain. This artistic sense and breadth of scope gave to his work an interest and a popularity not known in the case of many historians. A collection of eminent opinions on Prescott may be seen in the familiar ‘Dictionary of Authors,’ by Allibone. That his reputation was international is proven by the long list of literary honors which were showered on him. Besides being made a member of some 16 State historical societies in his own country, he was also elected to membership in the American Philosophical Society, Royal Academy of Science of Naples, American Antiquarian Society, American Academy of Arts and Sciences, Herculaneum Academy of Naples, National Institute, French Institute, Royal Society of Berlin, Royal Society of Literature of London, Mexican Society of Geography and Statistics and Royal Irish Academy. He received honorary degrees from Columbia College, South Carolina; Harvard; Columbian College, Washington, D. C.; Oxford University, England. His contributions to periodicals were collected under the title of ‘Biographical and Critical Miscellanies’ (New York 1845; London 1861). A complete edition of his work has been published in 15 volumes (new ed. 1890). Consult Ogden, R., ‘William Hickling Prescott’ (Boston and New York 1904); Peck, H. T., ‘W. H. Prescott’ (New York 1905); Ticknor, G., ‘Life of W. H. Prescott’ (Boston 1864); Bassett, J. S., ‘The Middle Group of American Historians’ (New York 1916).

PRESCOTT, Ariz., city, county-seat of Yavapai County, on the Santa Fé, Prescott and Phœnix and on the Atchison, Topeka and Santa Fé railroads, about 135 miles north of Phœnix, the capital of the State. The plateau upon which the city is situated has here an altitude of 5,347 feet. Prescott was named in honor of the historian William Hickling Prescott (q.v.) and was formerly the capital of Arizona when it was still a Territory. It is in the midst of a rich mining region; the chief minerals mined in the vicinity are copper, silver and gold. Considerable attention is given to stock raising and farming, and there is some lumbering. Prescott has a hospital, a Carnegie library, a courthouse, four banks with total deposits of over $6,000,000, and three newspapers. The educational institutions are Saint Joseph's Academy, public and parish schools. Pop. 5,092.

PRESCOTT, Ark., city and county-seat of Nevada County, 30 miles southwest of Arkadelphia, on the Saint Louis, Iron Mountain and Southern and on the Prescott and Northwestern railroads. It is located in a cotton-growing district, has a large trade in this article and also in lumber, livestock, eggs and poultry, butter, furs and wool. Pop. 2,705.

PRESCOTT, Canada, town and county-seat of Grenville County, Ontario, on Saint Lawrence River, opposite Ogdensburg, N. Y., 50 miles southwest of Ottawa, on the Canadian Pacific Railway. There are iron foundries, breweries, distilleries and creameries; and manufactories of starch, emery-wheels and caskets. Pop. 2,801.

PRESCRIPTION, *in medicine*, a statement or formula, usually in writing and made by a physician, containing directions for the preparation and use of medicines or remedies for a patient. Formerly prescriptions were written altogether in Latin, but in this country and in Scotland, English is now chiefly used for the directions, Latin being reserved for the names of ingredients. In England both prescriptions and directions are still usually written in Latin. In prescribing the physician may, from the nature of the case, use an officinal or extemporaneous preparation. Prescriptions are now much more simple than formerly. The parts of a regular prescription are four, as follows: (1) The superscription, with the date, name of patient and the sign ℞, an abbreviation of *recipe* (take); (2) the inscription, that is, the body of the formula, containing names and quantities of ingredients, the former in Latin, the latter according to apothecaries' measure or the metric system; (3) the subscription — directions for the apothecary; (4) the signature, comprising directions to the patient regarding the use of the medicines or remedies prescribed, and followed by the signature (sometimes initials) of the physician. In former times, when frequently very complicated prescriptions were used, every prescription was supposed to consist of four classes of ingredients. The most active of these is called the base; the *adjuvant* is meant to promote the action of the first; the *corrigent* or corrective is intended to modify that action; and to these is added the *excipient*, also called the *vehicle* for the purpose of imparting to the whole a form or consistency convenient and agreeable for use. Consult Barton, W. M., ‘Therapeutic Index and Prescription Writing Practice’ (Boston 1917); Maitland, L., ‘How to Read and Write Prescriptions’ (Chicago 1914); Mann, M. D., ‘Manual of Prescription Writing’ (6th ed., New York 1906); Prichard, A. H., ‘Practical Prescribing with Clinical Notes’ (Oxford 1914); Swan, J. M., ‘Prescription Writing and Formulary’ (Philadelphia 1910); Wall, O., ‘Prescriptions’ (4th ed., Saint Louis 1917).

PRESCRIPTION. *At common law,* right or title to incorporeal interests in land, as easements, acquired by possession for the time and in the method required by law. In some systems of jurisprudence, as in the civil law, the term has a much more extensive signification.

At common law prescription was originally based on the legal fiction that open, peaceful and uninterrupted possession for a long term of years raised a presumption of a grant, with the further fiction that this grant had been lost, so as to avoid the rule of pleading requiring profert. The fiction of a lost grant has now to a great extent been superseded. The doctrine is governed largely by statute in the United States. Formerly the period of possession necessary to acquire title by prescription was from time immemorial, or “from the time whereof the memory of man runneth not to the contrary.” To-day the period is usually fixed at 20 years, both in England and the United States, but by statutory regulation in the latter country it may be less and in rare cases even more. In Louisiana, however, which follows the civil law, the period varies with the subject, and the important distinction is made that the right is not restricted to incorporeal hereditaments. By the Prescription Act passed in England in 1832, later extended to Ireland, rights of common and other profits *à prendre* vest after 30 years, and the right ordinarily becomes absolute after 60 years. The period of prescription does not run against an owner of land while he is under legal disability, as insanity. Rights of way and drainage may be acquired by prescription in the United States, but not to lateral support or light. In some States it is denied that easements by prescription may be acquired against a railroad, but in other States this right is declared to exist. As prescription is founded on the theory of a grant, the use or possession on which it is founded must be adverse. It is, therefore, a well-settled principle of law that use by express or implied permission, irrespective of the length of time continued, cannot ripen into an easement by prescription. In the United States generally evidence of adverse user must be clear and positive, and usually it is a question of fact for the jury. In England, however, the Prescription Act renders the possession a bar or title of itself, without the necessity of the intervention of a jury.

The term had several distinct meanings in Roman law. In procedure a prescription was a legal plea sent by the prætor to the referee to be examined before other disputed issues. The term was also applied to a right or title acquired by uninterrupted possession of property. In the case of movables the period required was fixed at three years by the legislation of Justinian, while for immovables it varied, being 10 years where the parties were domiciled in the same province and 20 years where domiciled in different provinces. However, title by prescription could not be secured to public property nor to property acquired by theft or violence. At one period it required continued possession varying from 40 to 100 years to give title by prescription to church property. Later the same rule was applied to church property as to public property. The term was also used in Roman law to apply to lapse of time after which actions were barred, first limited to equity, but later extended to all cases.

In the law of Scotland, the term is used in a broader sense than in England or the United States and includes limitation in English law. Though originating in the common law, it is governed by statute in Scotland.

Statutes of prescription are statutes of repose. Prescription is justified on the ground that public policy and convenience require that long possession should not be disturbed, and also because there is a social need of settling controversies and of affording relief to those who necessarily find it exceedingly difficult to furnish proof of title on account of great lapse of time. Concerning corporeal interests in real property and title to personal property by lapse of time, see ADVERSE POSSESSION; LIMITATION OF ACTIONS.

EDWARD F. DONOVAN.

PRESENTATION, *in ecclesiastics,* means the nomination of one or several candidates to a vacant office in the church. In ecclesiastical benefices the usual rule is that if the patron fails to present within six months after a vacancy has been intimated to him, the *jus devolutum* takes place; in other words, the patron loses his right, which in consequence devolves on the party before whom the presentation should have been laid, as the bishop under Episcopacy and the presbytery under Presbyterianism.

PRESENTATION AT COURT. See COURT, PRESENTATION AT.

PRESENTMENT, *in law,* is properly speaking the notice taken by a grand jury of any offense, from their own knowledge or observation, without any bill of indictment being laid before them at the suit of the government; as the presentation of a nuisance, a libel or the like, upon which the officer of the court must afterward frame an indictment before the party presented can be put to answer it. The term is also used to include inquisitions of office and indictments by a grand jury; the Constitution of the United States uses the terms "presentment," "indictment" and "charge" interchangeably and as referring to the first step in the prosecution of a crime.

PRESERVATION, Fort. See OSWEGATCHIE.

PRESERVATION OF FOOD. See FOOD PRESERVATION.

PRESERVATIVES. See ANTISEPTIC.

PRESIDENCY. See PRESIDENT; UNITED STATES — PRESIDENT'S OFFICE.

PRESIDENT, signifying he who presides. The title is used for: (1) the principal member of a society or association, who takes the chair when present at meetings; (2) the chief official of a company or board; (3) the head of a university or college or of a learned faculty; (4) the elected chief magistrate of a republic. At the present time the following countries, all having some form of democratic government, have Presidents as chief magistrates: Andorra, China, France, Liberia, Portugal, Russia, San Marino, Switzerland. All the Central and South American countries, not any longer colonies of European countries, are now republics with a president at the head of their administrations. To this group belong Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, El Salvador, Uruguay, Venezuela. The powers, duties, etc., of the presidents of these countries are, of course, regulated by their several constitutions and differ to a considerable extent. Further details will be found in the articles on each country. In the United States the President is the chief executive of the government. His duties, rights and election are defined by the Constitution of the United States, article II, sections I, II and III, and article XII of the amendments. He is commander-in-chief of the army and navy of the United States and of the militia of the several States when called into the actual service of the United States. He has the power to grant reprieves and pardons for offenses against the United States except in cases of impeachment. With the advice and consent of the Senate he has the power to make treaties and to nominate and appoint ambassadors, consuls, judges of the Supreme Court, most of the executive offices of the government and a large number of judicial and administrative functionaries. He is elected for a term of four years and is eligible for any number of re-elections, though, in conformity with the precedent set by George Washington, no President has yet been elected more than twice. The President has a veto power. His salary was originally placed at $25,000. In 1873 it was increased to $50,000. In 1907 he was allowed an additional $25,000 for traveling expenses and in 1909 the salary itself was increased to $75,000. His residence during his Presidency is the White House in Washington. He is elected by an electoral college, the composition and procedure of which is regulated by the Constitution, article II, section I, paragraph II, and article XII, amendments to the Constitution. He may receive a minority of the popular vote and yet be legally chosen to the office. He can be removed from office on impeachment for and conviction of treason, bribery or other high crimes and misdemeanors. On the entrance of the United States in the war in April 1917 the regular powers of the President, as defined by the Constitution, were extended and enlarged temporarily in various directions by means of special legislation. These extra powers, however, were given to the executive only for the duration of the war. In case of his death or total disability the functions of the office devolved on the Vice-President, who is elected coincidently with the President and is the presiding officer of the Senate. (See Presidential Succession). The following is the list of Presidents up to the present: George Washington, 1789 and 1793; John Adams, 1797; Thomas Jefferson, 1801 and 1805; James Madison, 1809 and 1813; James Monroe, 1817 and 1821; John Quincy Adams, 1825; Andrew Jackson, 1829 and 1833; Martin Van Buren, 1837; William Henry Harrison (died 4 April 1841), 1841; John Tyler (elected as Vice-President), 1841; James Knox Polk, 1845; Zachary Taylor (died 9 July 1850), 1849; Millard Fillmore (elected as Vice-President), 1850; Franklin Pierce, 1853; James Buchanan, 1857; Abraham Lincoln (assassinated 14 April 1865), 1861 and 1865; Andrew Johnson (elected as Vice-President), 1865; Ulysses S. Grant, 1869 and 1873; Rutherford B. Hayes, 1877; James A. Garfield (died by assassination 19 Sept. 1881), 1881; Chester A. Arthur (elected as Vice-President), 1881; Grover Cleveland, 1885; Benjamin H. Harrison, 1889; Grover Cleveland, 1893; William McKinley, 1897 and 1900 (assassinated 6 Sept. 1901); Theodore Roosevelt (elected as Vice-President) 1901 and 1905; William H. Taft, 1909; Woodrow Wilson, 1913 and 1917.

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PRESIDENT, The, the name of an American frigate of 44 guns, built in New York in 1794, and playing an important part in the early part of the War of 1812 (q.v.). In the summer of 1812 she was made the flagship of a small squadron under the command of Capt. John Rodgers, and in June of that year she had a fight with the British ship *Belvidere*. The latter, after having been hit a number of times, just managed to make her escape. In the summer of 1814 Commodore Decatur was transferred to the *President*, the command of which he assumed. On 15 June 1815 the *President*, then lying in the Hudson, successfully ran the English blockade of New York Harbor with the intention of making a cruise to the East Indies for the purpose of attacking English shipping there. However, before she got very far she was attacked by four British ships-of-war of superior speed and strength. With one of these, the *Endymion*, she had a running fight lasting for two and a half hours. At the end of that time the other three British ships came up and made a simultaneous attack on the *President*. Appreciating the impossibility of further resistance Decatur struck his colors. The *Endymion* with her prize sailed for Bermuda, but before arriving there both ships were dismasted in a heavy gale.

PRESIDENT AND ENDYMION, Battle of the, in the War of 1812. The blockade of the American coast by British ships was very strict and so effective that the frigates *United States* and *Macedonian* were dismantled in April 1814 at New London, and Stephen Decatur (q.v.) and his crew were transferred to the *President*, then at New York. On the night of 14 Jan. 1815 Decatur decided to run the blockade and as a severe snowstorm and heavy gale had driven the blockading fleet out of sight he attempted to make for the open. Through a mistake of the pilot the *President* grounded while crossing the bar but the wind forced her across and despite her injuries she was compelled to proceed. Decatur hugged the Long Island shore for 50 miles, but at early dawn ran into the British squadron consisting of the *Baltic*, 56, the *Endymion*, 50, the *Pomone* and the *Tenedos*, 38's. These three promptly gave chase but being the fastest sailer the *Endymion* left the others in the rear and at 2:30 P.M. exchanged shots from her bow chasers with the stern guns of the *President*. At 5 o'clock the *Endymion* crept up on the *President's* starboard quarter, raked her for half an hour and punished her so severely that Decatur attempted to board his antagonist with the idea of capturing her, scuttling his own ship and escaping on the British ship. But the British captain yawed his ship, whereupon Decatur poured such a galling fire into her that she was reduced to a wreck. He then attempted to escape but at 11 o'clock the *Pomone* and *Tenedos* came up and opened fire. “Thus situated,” says Decatur, “with about one-fifth of my crew killed and wounded, my ship crippled and more than four-fold force opposed to me, without a chance of escape left, I deemed it my duty to surrender.” The loss on the *President* was 25 killed and 60 wounded; on the *Endymion*, 11 killed and 14 wounded. Consult Adams, Henry, ‘The United States’ (Vol. IX, pp. 65–70); Barnes, James, ‘Naval Actions of the War of 1812’ (pp. 219–227); Cooper, J. F., ‘Naval History’ (Vol. II, pp. 235–238); James, William, ‘Naval Actions’ (pp. 82–94); Maclay, E. S., ‘History of the Navy’ (Vol. II, pp. 64–70); Roosevelt, ‘Naval War of 1812’ (pp. 402–405); Spears, J. R., ‘History of Our Navy’ (Vol. II, pp. 215–228), and biographies of Decatur by T. C. Brady, S. P. Waldo and MacKenzie.

PRESIDENT AND LITTLE BELT, Affair of the. Prior to the War of 1812 British ships were accustomed to hover off American ports and commit depredations on American merchantmen. Accordingly Com. John Rodgers (q.v.) was ordered to sail with his flagship, the *President*, 44 guns, to stop this unlawful interference. On 10 May 1811 Rodgers sailed from Annapolis and at noon of the 16th sighted a ship supposed to be the British *Guerrière*. At 2 o'clock he set a broad pennant and ensign whereupon the stranger began to make signals and stood to southward. Rodgers gave chase and at 8:30 came within speaking distance, but the stranger answered his hail with a solid shot in the mainmast. Before Rodgers could prevent it, a lieutenant on the *President* replied in kind; the two ships then fought for 20 minutes when the stranger was completely disabled. She proved to be the British corvette *Little Belt*, 22, Capt. A. B. Bingham. The British lost 32 men killed and wounded and the Americans 2 wounded. Consult Dawson, ‘Battles of the United States’ (Vol. II, chap. XIII); the official records and evidence of the court-martial of Rodgers in ‘American State Papers, Foreign Relations’ (Vol. III, pp. 473–498); Annals of Congress, 12th Congress, 1st session, Pt. II, pp. 1874–1930; Lossing, ‘War of 1812’ (pp. 181–184); Paullin, Charles O., ‘Commodore John Rodgers’; Wiley and Rines, ‘The United States’ (Vol. V, pp. 246–247).

PRESIDENTIAL ELECTIONS. See ELECTIONS; VOTES; ELECTORAL QUALIFICATIONS; ELECTORAL COMMISSION; ELECTORS, UNITED STATES PRESIDENTIAL; UNITED STATES — CONTESTED PRESIDENTIAL ELECTIONS; PRIMARY, PRESIDENTIAL PREFERENCE.

PRESIDENTIAL ELECTORS. See ELECTORS, UNITED STATES PRESIDENTIAL.

PRESIDENTIAL SUCCESSION, the order in which a vacancy in the office of the President of the United States can be filled pending a new election. The 49th Congress passed a measure entitled “An Act to provide for the performance of the duties of the office of President in the case of removal, death, resignation or inability both of the President and Vice-President.” The measure was approved by the President 19 Jan. 1886. The text is as follows:

§ 1. Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That in case of removal, death, resignation, or inability of both the President and Vice-President of the United States, the Secretary of State, or if there be none, or in case of his removal, death, resignation, or inability, then the Secretary of the Treasury, or if there be none, or in case of his removal, death, resignation, or inability, then the Secretary of War, or if there be none, or in case of his removal, death, resignation, or inability, then the Attorney-General, or if there be none, or in case of his removal, death, resignation, or inability, then the Postmaster-General, or if there be none, or in case of his removal, death, resignation, or inability, then the Secretary of the Navy, or if there be none, or in case of his removal, death, resignation, or inability, then the Secretary of the Interior, shall act as President till the disability of the President or Vice-President is removed or a President shall be elected: Provided, That whenever the powers and duties of the office of President of the United States shall devolve on any of the persons named herein, if Congress be not then in session, or if it would not meet in accordance with law within 20 days thereafter, it shall be the duty of the person on whom said powers and duties shall devolve to issue a proclamation convening Congress in extraordinary session, giving 20 days' notice of the time of meeting.

§ 2. That the preceding section shall only be held to describe and apply to such officers as shall have been appointed by the advice and consent of the Senate to the offices therein named, and such as are eligible to the office of President under the Constitution, and not under impeachment by the House of Representatives of the United States at the time the powers and duties of the office shall devolve upon them respectively.

Consult Hamlin, C. S., ‘The Presidential Succession Act of 1886’ (in *Harvard Law Review*, Vol. XVIII, p. 182, Cambridge 1905); Willoughby, W. W., ‘Constitutional Law of the United States’ (2 vols., New York 1910).

PRESIDENT'S MARCH, the title of a popular American national air, most likely composed about 1793 by Philip Phile, a Philadelphian musician, although it is claimed by some authorities to have been played for the first time on Trenton Bridge as Washington rode over it on his way to be inaugurated. In 1798 Joseph Hopkinson of Philadelphia wrote the words of ‘Hail Columbia’ to the air and it became immensely popular. Consult Sonneck, O. G. T., ‘Report on the ‘Star-Spangled Banner,’ ‘Hail Columbia,’ etc. (Washington 1909).

PRESIDENT'S OFFICE. For the history of the President's office, see UNITED STATES — PRESIDENT'S OFFICE.

PRESIDENTS OF THE UNITED STATES, Family Coats-of-Arms of. One-half of our 28 Presidents possess either through the paternal or maternal side heraldic bearings, while four additional executives come into heraldic relationship by marriage. The study of these heraldic symbols is not only interesting, but profitable, since they suggest much which is of historic importance and bring to the surface accurate genealogical connections between them and great families of the past.

The grants of arms were not given in recognition of royal blood, but were honors conferred on the ancestors of our Presidents because of some special merit, achievement, heroism or patriotic valor. Hence, the pride we have in their shields, crests or supporters is «born of high record.» The frequent association of aristocracy with this meritorious form of heraldic bearings is an error and none so often has this misconception as the American. While the former pertains to regal blood the latter, an entirely different mode of distinction, relates to honor and personal worth and they have nothing in common other than the expression of heraldic emblems. No relationship exists between these two branches of armorial devices, the latter antedating the caste or titled aristocracy by generations, centuries and decades, for family arms and national insignia are of most ancient conception, as papyrus, stones, edifices and scripture will attest.

George Washington's people came from England, where centuries ago they were known as De Wessingtons and their immediate ancestors came from France, with William the Conqueror, and the original family name was William de Hertburn and he was knighted in the 12th century. In the «Balden Book» a record is made of all the estates of the people of Durham; in 1183 is found the entry that William de Hertburn of Hertburn, France, took the manor Wessington in exchange for soldierly service. With this grant Sir William de Hertburn became Sir William de Wessington. In these olden times «when knights were bold and barons had their sway» this Wessington served his king, being among the preux chevaliers, fighting, hawking, gaming, conspiring, conquering and feasting, the king granting him a silver shield upon which were two golden bars, surrounded by three spurs of the knight in red with a crest of the black raven emerging from a ducal coronet.

In the great struggle of Charles I, the Washingtons remained loyal to the king and upon the promotion of Cromwell the Washingtons eagerly sought refuge in the Virginia colony, where they prospered and were men of great estates. Washington, our first President, devoted considerable attention to the investigation of his pedigree. The public is familiar with his frequent blazoning of the family arms on carriages, books, plate, mirrors, private seal, dishes, pictures and practically every memorable family token was decorated with the old shield of the English Washingtons. As a book plate all the Washingtons employed the family arms, both in England and America.

John Quincy Adams in a communication writes: «That the fact of my father securing this high position and rank at Harvard was due rather to the position of the maternal branch of the family than to the Adamses.» This is strange reading to Americans of this day. The coat of arms of the Adams family was a red shield with a silver cross upon which were five mullets of gold; the crest, a demi-lion emerging from a ducal crown.

Jefferson was eager about knowledge of the early Jeffersons and was well acquainted with the lineage. On 20 Feb. 1771 he wrote Thomas Adams of London (Vol. 81, p. 205, *Harper's*) a letter, in which the following request appears: «One further favor and I am done; to search the herald's office for the arms of my family. I have what I have been told were the family arms, but on what authority I know not.» Jefferson's book-plate and personal seal consisted of his monogram, about which were the words: «Rebellion to tyrants is obedience to God.» A distant relative in preparing the domestic «Life of Thomas Jefferson,» by Sarah V. Randolph, had the Jefferson arms prominently blazoned on the cover of the volume and Jefferson's private seal decorates the title-page. The coat-of-arms of the Jeffersons was a deep red, upon which blazoned three leopards base with cross of Saint Andrew entwined with a lozenger and field blue crest a demi-lion proper. See GREAT SEAL OF UNITED STATES.

The next stratum of American history brings us to the administration of James Monroe, of the ancient Monroe or Munroe family, noted for their studiousness and mildness of character. The family escutcheon of gold was of English origin and contained a spread eagle. In beak a sprig of laurel proper; crest same as arms; motto, «Dread God.» Crest eagle's head erased gules.

The ancestors of Andrew Jackson were Scotch by blood, though they came from the geography of Ireland and in 1765 we find the Jackson family. Generations ago these people were prominent in the wars of Great Britain and the mark of distinction which came to them consisted of a silver shield with a fess or bar, with three birds blazoned; the helmet had perched upon it a bird and a shell supported the shield. The motto, «I move carefully.»

Then comes John Quincy Adams with an armorial device. He inherited a love for the heraldic and early in his life used the Adams crest as a book mark, but later in life he employed in connection with the crest a shield, upon which were blazoned the arms of his ancestors, both paternal and maternal. He was a deep student of things heraldic and while he was Secretary of State he devised and used — contrary to any authority — a private device as the seal of the Department of State. It was his heraldic idea of the constellation Lyra, infrequently referred to in the act creating our national flag, the lines reading «Thirteen stars, representing a new constellation.» See FLAG OF UNITED STATES.

The name Harrison throughout national life is redolent of patriotic intellectual greatness. The family insignia was «a golden shield upon which were two ermine bars and, spangled on shield, five silver stars, with a lion as a crest.»

President Tyler's wife was a Miss Julia Gardiner, of a distinguished family who owned by kingly grant the island of Gardiner of New York. Their coat-of-arms, which can at this day be seen on the walls of this colonial manor house, was «Arms of silver with three hunters' horns and chevron (roof shaped), red crest, an armor with visor surmounted by an arm holding a baton.»

Millard Fillmore family arms were Sable, three bars in chief, three cinquefoils.

President James Buchanan was a descendant of James Buchanan, who came from Ireland just as the American Revolution closed, settling in Pennsylvania. From a book-plate and also from a tombstone at Christ Church Cemetery, Philadelphia, the coat-of-arms of his family is obtained a golden shield blazoned with lion, the helmet is surmounted by a rose, the mottoes «Supported by Courage» and «Honorable Reflection.»

In our backward journey we find Rutherford Birchard Hayes as one of an heraldic family. Little, indeed, is known of the ancestry of Mr. Hayes, though the family has cherished a purple shield, upon which are blazoned three lesser shields of silver. He was of Scottish ancestry, the first member of the family in America being George Hayes, who settled in Windsor colony of Connecticut in 1682. The Scottish ancestry were granted the arms early in the 15th century as a distinction for profound ability at the bar, a heritage which made the branch of progress easy for the scholarly Hayes.

Garfield's shield of gold, with its three bars of red and its right canton with cross and left canton with heart, is symbolic of the armorial ancestral device. As a crest the arm clasping a sword and for a motto those significant words «In the cross I conquer.» The name and the arms are possibly of Saxon origin, for the name occurs in the Teutonic heraldic insignias as meaning «Garfeld» or «watch of the field» and the crest is of crusade origin, the remote Garfields having been a part of the noble army of religious patriots.

Benjamin H. Harrison was the 23d President and his armorial device the same as William Henry Harrison.

The name Cleveland is, in truth, not the name of this great American family, but rather the designation of the immense estate they once possessed in England, where these folks were known as «De Cleveland» of Durham, England. This French nobiliary predicate «de» formed a part of this family name up to the 13th century, some genealogists claiming their ancestry French and hence the French word «of» prefacing the name. The Clevelands have an armorial bearing which dates back to the remote period of the 12th century and the crest, which represents a spearman, is in token of Sir Guy de Cleveland, who commanded the spearman at the famous battle of Poiclien-Poitiers of 19 Sept. 1356. The Cleveland shield, with its black chief and silvery base spangled with stars and its argent chevron (roof) with stars, once formed the book-plate of Stephen Cleveland, father of the Hon. Grover Cleveland. The motto in this coat-of-arms is especially appropriate, meaning «For God and Fatherland.»

The Roosevelts were in old New York when the Pilgrims of Massachusetts were banishing men and women for freedom in religious worship and executing so-called witches and tyrannizing the wilderness with self-destruction. At this same time the Dutch of New York were welcoming the world and laying the foundation of our present public-school system. In this atmosphere the Roosevelts flourished as early as 1649. The Roosevelt coat-of-arms in its heraldic colors was painted on the dining-room wall of old Jacobus Roosevelt and opposite in oils in a heavy frame was the likeness of Klaas Roosevelt, the first emigrant Roosevelt, who came as early as 1649 when New York was still New Amsterdam. The Arms are a silver shield charged with red roses and Latin motto, meaning «God who has transplanted it will protect it.»

The ancient Dutch grant of arms is interesting, though too lengthy to reproduce. Suffice the statement that this shield of honor was conferred upon his kin early in the 1500's, during the campaign leading up to the founding of the Dutch Republic. Needless to say, these Roosevelts or Van Roosevelts, as they were entered in record, were of the Republican party and of the Protestant army.

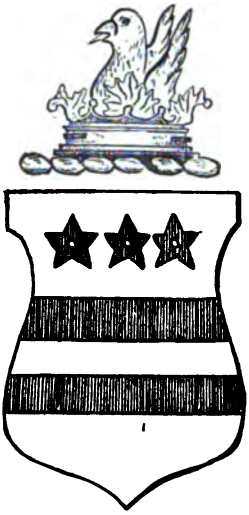
B. J. CIGRAND,
Author of 'Our Presidents' and 'Heraldic Americana.'

PRESIDENTS OF THE UNITED STATES, Graves of the. Some writers and distinguished citizens have advocated bringing to the capitol the remains of all the Presidents and depositing same in a huge mausoleum patterned after the Westminster Abbey of London. This would be a mistake, since State pride and individual requests rebel against such procedure. Let the States have their spots of historic interest. This will impel people to visit various parts of the Union. Besides, a certain «love of home» induces men, even of broad and liberal minds, to choose a burial spot, or God's acre, within the precincts of youthful days or within the vicinity of faithful friends. This latter sentiment was the one uppermost in our Presidents selecting their own last earthly home and Washington's notion on this theme was borne out by many of his successors.

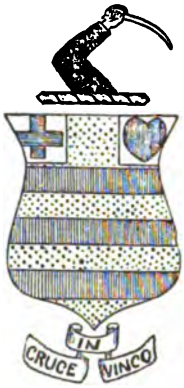
While there are innumerable magnificent memorials, monuments, statues and tablets to the eminent dead who filled the highest chair in the gift of a republic, these are for the most part distant from their graves and though these markers in stone, metal or wood represent a form of gratitude, yet the actual tomb, its surroundings and general care is the emblem of our affections.

Washington.

The one of Washington, at Mount Vernon, is commonplace. It does not reflect the sentiment of our people. The national treasury could very fittingly unlock one of the gold boxes and contribute toward the shrine of him who, when living, was «first in war, first in peace,» and, in life or in death, «first in the hearts of his countrymen.» Thousands are the men, women and children who annually make the pilgrimage to this patriot's grave. It is indeed a shrine worthy of national regard, and while the entire republic in all its material grandeur is as a monument to his wisdom and heroic patriotism, yet his immediate tomb de-



WASHINGTON



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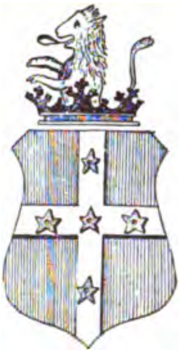

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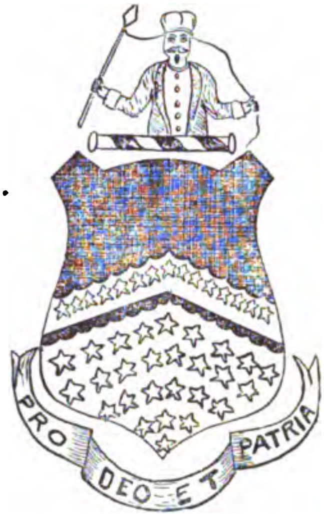

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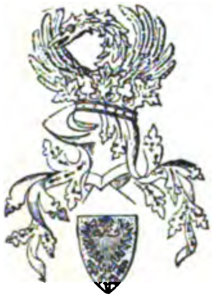

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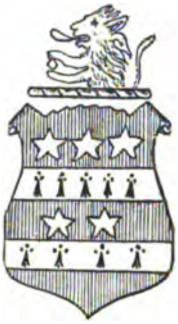

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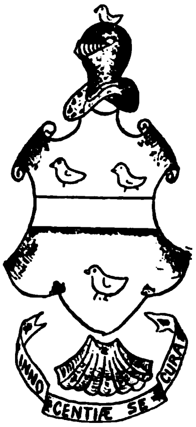

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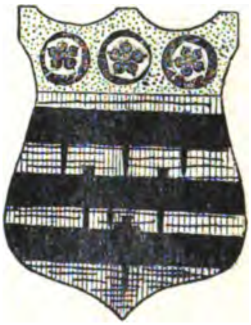

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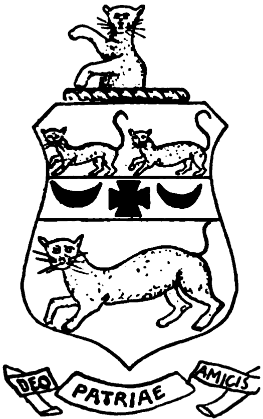

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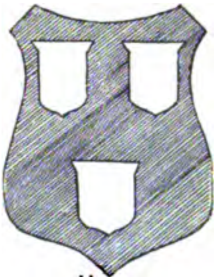

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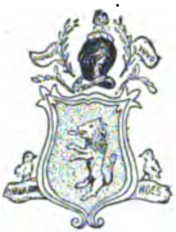
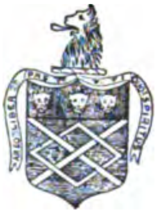
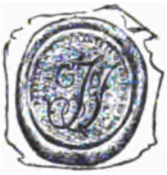


BUCHANAN



JEFFERSON



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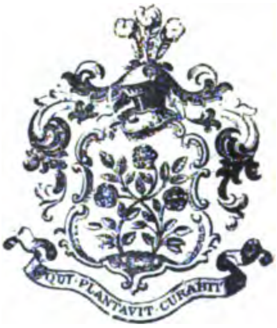

ROOSEVELT

COATS OF ARMS OF AMERICAN PRESIDENTS

serves a more extravagant materialization to be an equivalent to the popular regard.

Miss Alice Longfellow, youngest daughter of New England's beloved poet, told the story to the Warren and Prescott chapters, Daughters of the American Revolution, of how Mount Vernon was saved to the nation by a woman. Miss Longfellow told of Miss Ann Cunningham, a gentle woman of old Virginia, who, when passing up the Potomac River one day in 1853 and hearing the steamer bell toll when passing the grave of Washington, became possessed with the desire to restore it. The place was then occupied by a great-grandnephew of the first President, John Augustine Washington. It was in a state of decay and the generous hospitality of the owner, who treated every passing stranger as a guest, made the expenditure of money for repairs utterly impossible. When Miss Cunningham ventured to tell him of her plans he was filled with horror that women should do that which should so emphasize the degeneracy of men. But the determined woman sent out urgent appeals.

Her first call was to the women of the South and on 12 July 1854 the first meeting was held. Edward Everett was one of the first to offer his services and as the result of his lectures $68,000 was contributed to the fund.

In addition to the actual price of the plantation $300,000 had to be raised for repairs and when matters were progressing finely the Civil War broke out and confusion was the result. Mount Vernon was neutral ground throughout the bitter struggle. When the strife was ended Miss Cunningham went there to live, received the aid of Sumner in getting an indemnity from the government and went on with the noble work she had undertaken.

It may not be generally known, but such is the case nevertheless, that when the capitol of the United States was planned and erected at Washington a crypt was constructed in the basement of the capitol, directly underneath the rotunda. This final resting place was designed for the body of Gen. George Washington. Considerable mystery surrounds the delay or refusal of the entombing of the first President in the foundation of the national capitol. Some claim that neglect of action on the part of our national Congress is responsible for the empty crypt, while others, equally good authority, states that Washington's wish dictated his present grave on the premises of old Mount Vernon, the spot of all others he so devotedly loved.

JOHN ADAMS.

The death of John Adams and of Thomas Jefferson 4 July 1826 is the most remarkable necrological coincident in the history of our country. Adams married a minister's daughter and he was a devout Christian, affiliating with the Unitarians of Braintree, Mass., and under the pulpit of this antique religious structure reposes all that is earthly of the eloquent gentleman who made the Declaration of Independence an accepted national decree. He is incased in a leaden coffin, which is sealed in a stone sarcophagus. His son, John Q., placed a huge marble tablet at the right of the pulpit, with these inspiring words:

From lives thus spent
  Thy earthly duties learn;
From fancy's dreams
  To active virtue turn.

Let Freedom, Friendship, Faith
  Thy soul engage,
And serve, like them,
  Thy country and thy age.

THOMAS JEFFERSON.

Thomas Jefferson, whose labors so thoroughly complemented those of John Adams, rests in Williamsburg, Va., beneath a plain and unassuming obelisk of granite, in the small family cemetery on the road leading to his famous homestead, Monticello. He did not regard having been twice elected to the Presidency the height of his accomplishments, as is shown by the burial tablet he wrote for his own tomb, the character of which he designed. The lines he wished blazoned on the granite read: «Here lies buried Thomas Jefferson, author of the Declaration of Independence, of the statute of Virginia for religious freedom, and father of the University of Virginia.»

The Democrats, aided by Republicans, will erect at Washington, D. C., the most elaborate memorial to Jefferson ever erected to any famed person. But his body will not be disturbed from its present resting place because of Jefferson's request to lie at the side of his loved ones. The spot he selected when yet a young man. On a fly-leaf of one of his old books was found this regarding his burial: «Choose some unfrequented vale in my park, where is no sound to break the stillness, but a brook that, bubbling, winds among the woods. Let it be among the ancient and venerable oaks.» The obelisk has been practically destroyed by crazed relic hunters, who have beaten and battered the granite until only a few letters tell whose grave it is. Vandalism of an insane origin only could be responsible for such desecration. Why does not the central government awaken to the duty it owes to the dead national Presidents? An infinitesimal fraction of the protective tariff revenues would make these graves truly shrines for the inculcation of national patriotism.

JAMES MADISON.

He lies buried on the centre of his old farm at Montpelier, Va. A brick fence encloses his bier, a lot measuring about 100 square feet. A granite obelisk 20 feet high marks the spot, and on its base are these words: «Madison, born March 16, 1761.» The lovable and gracious Dolly Madison, his wife, has an obelisk of smaller dimensions near by.

JAMES MONROE.

New York City for 27 years had the body of James Monroe, but on 4 July 1858, it was removed to the capital of Virginia, where it now rests in Hollywood cemetery. The monument is unique and patterned after the windows of a Norman abbey. The General Assembly of Virginia looks after this grave, and it is kept up with reverential care.

JOHN QUINCY ADAMS.

In the crypt at Braintree, Mass., is the body of John Quincy Adams. He loved his parents dearly, and it was his wish to be buried at their side. He was religious, and when President he prayed the prayers of his childhood days. He related at a Cabinet meeting that the sweetest lines in the English language were those of the prayer which begins: «Now I lay me down to sleep; I pray thee, Lord, my soul to keep." On his tomb tablet are these lines: «A son worthy of his father, a citizen shedding glory on his country, a scholar ambitious to advance mankind. This Christian sought to walk humbly in the sight of God.»

ANDREW JACKSON.

Eleven miles from Nashville, Tenn., is the famous shrine, «The Hermitage,» the home of Andrew Jackson, and in the garden of this notable farm is the quiet resting place of the stern and fearless «Old Hickory.» On the base covering the graves of Jackson and his wife are erected eight fluted columns which support a circular cope surmounted by an urn. This old plantation, with its sacred remains, was cared for by the women of Tennessee, and they have now presented this estate to Tennessee, hence the State is guardian. The words «General Andrew Jackson, born March 15, 1767, died June 8 1845,» are all that relate to the soldier President, while a lengthy inscription, written by himself, is engraved into the stone above his amiably tempered wife.

MARTIN VAN BUREN.

The grave of Martin Van Buren is at Kinderhook, N. Y., and is marked by a plain granite obelisk with simple inscription stating he was the eighth President of the United States.

WILLIAM HENRY HARRISON.

Fifteen miles west of Cincinnati, Ohio, lies all that was mortal of W. H. Harrison. The old brick vault was recently replaced by stone, the inscription is wanting and patriotic societies contemplate improving the surroundings.

JOHN TYLER.

The American people have lost track of the grave of John Tyler. Church records place it near the grave of James Monroe. A magnolia tree serves as a marker; neither stone, flowers nor urn indicate the place of his burial. While it is true that he did not remain loyal to the Union — taking up the cause of the Confederacy, and being an ardent advocate of State's rights — he nevertheless was a dutiful and respected Virginian, and held the office of President. The government might appropriate the regulation soldier marker — costing about $5. This would serve to give designation to the spot until future generations more befittingly recognize it.

JAMES K. POLK.

Within the capitol grounds at Nashville, Tenn., rest the remains of James K. Polk. He certainly has a beautiful resting place. The high hill on which it is located overlooks the great landscape of Tennessee, and miles away can be seen with fieldglass the grave of Jackson, and Nashville, the Athens of the Southland, is proud of these two graves and reveres the sacred remains there deposited. A lengthy and praiseworthy inscription graces the Grecian Doric pillared grave.

ZACHARY TAYLOR.

A curious oversight regarding the death of General Taylor comes to light in the truth that the 12th President, who died in the office as President, has never received burial services. Gen. Richard Taylor, nephew of the President, writes: «General Zachary Taylor has never been buried, notwithstanding the many stories to the contrary. He died in 1850 and his remains were immediately brought to Kentucky by his brother, Commissary General J. P. Taylor, and placed in a vault in the Taylor cemetery.» This cemetery is about five miles from Louisville, Ky. On the monument are these splendid words from the General: «My only regret is for the friends I leave behind me.»

MILLARD FILLMORE.

About two miles from Buffalo, N. Y., is Forest Lawn cemetery, and here a plain obelisk rises into the sky to designate the final home of President Fillmore. The word «Fillmore» is on the base, but it does not state that he was an American President. The grave is kept in most befitting manner.

FRANKLIN PIERCE.

Far north in the hills of old New Hampshire, near the famous town of Concord, in Minot cemetery, a delicately designed pillar monument marks the grave of Franklin Pierce. A strange mistake on the tomb shows: «Francis Pierce, born Nov. 23, 1804; died Oct. 8. 1869.» On the same lot are buried his two sons, Robert and Franklin, hence the entire family is dead.

JAMES BUCHANAN.

Pennsylvania, with all its glorious history, with its thrilling scenes in Philadelphia, has had but one man in the White House. This «fortunate son» was James Buchanan, who «rests in peace» at Lancaster in Woodward Hill cemetery. No wife lies at his side. He was a bachelor President. Disappointed in love he remained single to the end of life. The magnificent block monument, with presidential reference, is pointed out with pride by the Pennsylvanians.

ABRAHAM LINCOLN.

To us the name of Lincoln is justly associated with all that stands for truth and justice, and to his fair name time only can add the laurel. His great and grand character will be more thoroughly understood as time rolls on. His life will appear in clearer light and be more fully appreciated by the generations yet to come. And the hour is close at hand when the name Lincoln will be nearer that of Washington than that of any other in the long calendar of fame.

The massive granite structure in which he «sleeps the eternal sleep» is of a Masonic character, and upon its four fortlike bays rest copper figures representing the heroic charges of the men who saved the Union. Like for Jefferson, the American people have contributed toward erecting on the old «Lincoln home» in Kentucky, where he was born, an elaborate memorial to be in the form of the White House, as that structure was at the time of his tragic death.

ANDREW JOHNSON.

Several years before the death of Andrew Johnson he chose the spot where he hoped to be buried. This place was on the heights of Greeneville, Tenn. It is not generally known that he had two sons in the Civil War. Charles was killed at Nashville and Robert, a colonel of a Tennessee regiment, died in 1869. Both are buried near the graves of the parents.

ULYSSES S. GRANT.

A most imposing structure on the banks of the Hudson marks the final resting place of Gen. U. S. Grant. Its grand proportions and its matchless location attract thousands annually. No President's death was made into such an expensive burial. It has been estimated that over $1,000,000 were expended. His funeral was the first real evidences that the North and South had become more than friendly; yea, the brotherly spirit here came to the surface. The Southland remembered the generosity of Grant at the surrender of Lee. They recalled how modestly, how tenderly and how fraternally he greeted General Lee on the day of Southern defeat. The death of the great Illinoisan brought not only wreaths of Southern posies, brought not only eloquence from Southern lips, but, more and better, tears from the defeated Southern hosts. No man received such universal homage, and he grows dearer and his character becomes nobler as time moves on. His tomb is a credit to the nation.

RUTHERFORD B. HAYES.

The Hayes tomb or monument was designed by President Hayes, and erected over his wife, who died in 1881, and near it he, too, was buried. Its splendid proportions are well known to the visitors at Oakwoods cemetery, Fremont, Ohio.

JAMES A. GARFIELD.

The tragic death of James A. Garfield brought forth general sympathy, and his costly tomb at Lakewood, Cleveland, Ohio, is evidence of his popular regard. Before his death he expressed the wish of being buried in this scenic cemetery. The structure cost $150,000, half of which was donated by his personal friends in Cleveland — a remarkable witness of his lovable character.

CHESTER A. ARTHUR.

Chester A. Arthur, the quiet, graceful and diplomatic New Yorker, sleeps in Rural cemetery, Albany, N. Y. Arthur and the scholarly gentleman who preceded him represented the two factions of the Republican party, but during the official life both were friendly.

WILLIAM MCKINLEY.

President McKinley, whose tragic assassination took place at a time when the country was just emerging from a cruel war and enjoying the calm, quieting words of a man who represented the «peace traits» of a happy people. His tomb at Canton, Ohio, and its speedy erection was due to the earnest and faithful coöperation of President Roosevelt and his praiseworthy Cabinet. The mammoth mausoleum cost $600,000.

The heroic statue of McKinley graces his mausoleum erected at Canton, Ohio. The statue of McKinley is depicted as he made his last public speech, just before his assassination at Buffalo, when he urged that «our real eminence rests on the victories of peace, not those of war.» The pose of the statue is familiar to the public, as it is taken from the photograph of President McKinley as he made this address. Instead of the awkward setting, however, that a balcony afforded for a statue, the sculptor has introduced a chair of state, over which the folds of an American flag appear.

GROVER CLEVELAND.

A handsome memorial is planned for Cleveland though a simple marker now shows where he is buried at Princeton, N. J.

BENJAMIN HARRISON.

Lies buried at Indianapolis, Ind., and a plain stone marks his resting place.

THEODORE ROOSEVELT.

Theodore Roosevelt was buried on 8 Jan. 1919 at Oyster Bay Cemetery, overlooking the beautiful landscape and waterflow of historic New York. There amid giant trees, wild fern and ocean breeze he chose to rest; great nature lover that he was it was but natural that the wildwood would claim his body. Quietly and without elaborate ceremonials he was deposited in the soil of his native State.

B. J. CIGRAND,
Author of ‹Our Presidents› and ‹Heraldic Americana.›

PRESIDIO, prę-sĭd'ĭ-ō, a Spanish word which means «a fort.» It is applied especially to four fortified Spanish forts on the coast of Morocco: Alhucemas, Ceuta, Melilla and Peñon de Velez. The military settlements made by the Spaniards in California were also known as presidios. In 1729 there were 20 presidios in New Spain, some of them founded as early as 1680 and most of them in what is now Mexico. The chief presidios of Spanish California were massive forts at San Franciso, Monterey, San Diego and Santa Barbara. Of these two, at San Francisco and Monterey, continued to be military posts after California was acquired by the United States. They are known officially as Presidio of San Francisco (q.v.) and Presidio of Monterey. The latter was founded in 1772 by the Spanish and at the present time contains 398 acres. Consult Richman, J. B., ‹California under Spain and Mexico› (Boston and New York 1911).

PRESIDIO OF SAN FRANCISCO, Cal., a United States military reservation in the northwest suburbs of the city of San Francisco. It contains 1,542 acres. It was established as a military post by Spain about 1776, and Mexico continued it until it was ceded to the United States in 1848. It was established as a United States military post in 1850, and is United States army headquarters for the Department of California.

PRESQUE ISLE, Me., town in Aroostook County, near Aroostook River, 135 miles, direct, northwest of Bangor, on the Bangor and Aroostook and the Canadian Pacific railroads. The town is situated in an agricultural district and manufactures starch and lumber. The population is increasing. Pop. 2,938.

PRESS, *in mechanics,* see METAL-WORKING MACHINERY; *in printing,* see PRINTING PRESS.

PRESS, Freedom of the, the right of every citizen to print whatever he chooses. The freedom, however, does not prevent his being amenable to justice for abuse of this liberty. The right of printing rests on the same abstract grounds as the right of speech, and it might seem strange to a man unacquainted with history that printing should be subjected to censorship, as it is still in some countries and has been at one time or another in all, any more than speaking, and that the liberty of the press should be expressly provided for in the constitutions of most free States. But when we look to history we find the origin of this, as of many other legislative anomalies, in periods when politics, religion and individual rights were confusedly intermingled. It is only since men's views of the just limits of government have become clearer that the liberty of the press has been recognized as a right; and to England and the United States the world is particularly indebted for the establishment of this principle. The existence of a censorship of the press was for centuries, however, deemed essential to the safety of all European governments. Liberty of printing, as we understand it, is a comparatively modern notion: Milton's plea for a free press met with no response from his own party, nor for many years later was it the cue of any party in the English commonwealth to refrain from suppressing the writings of their political opponents. In England the liberty of the press, soon after printing was introduced, was regulated by the king's proclamations, prohibitions, charter of license, etc., and finally by the court of star-chamber. The Long Parliament, after their rupture with Charles I, assumed the same power. The government of Charles II imitated their ordinances, and the press did not really become free till the expiration of the statutes restricting it in 1693, after which it was found impossible to pass new laws in restraint of it, and it has remained free ever since, the last restriction being done away with on the abolition of the newspaper stamp duty, in 1856. Such legal checks as remain are merely intended to prevent outrages on religion or decency, to protect individuals from defamation and to conserve the copyright of authors. The Constitution of the United States specifically prohibits Congress from passing any law abridging the freedom of the press. The constitutions of most of the United States declare, as we should expect, for the liberty of the press. The same may be said of all the South American republics. In other countries the amount of freedom enjoyed by the press varies considerably and is frequently regulated by executive laws. At the outbreak of the European War in 1914 the freedom of the press in all countries was involved, and even in some of the neutral countries, was greatly restricted, though these restrictions did not apply so much to the essential right of freedom as to details in connection with the printing of war news.

As recently as 1919 a decision of the Supreme Court of Mexico in a contempt case against the editor and publisher of a local journal cleared up several points concerning the freedom of the press and the law of contempt of court. The editor of the publication was found guilty of contempt of court by the judge whose actions he had criticized in an editorial, concerning a legal proceeding which affected the publication. An appeal taken to the Supreme Court contended «that the criticism made did not concern the official acts of the jurist, but merely his private act,» and this contention was upheld by the Supreme Court.

While adhering to the rule that criticism calculated to obstruct the course of justice may be punished as for a contempt of court, the court held that cases of constructive contempt are criminal proceedings and that, therefore, the information, the authority of the court, the weight of the evidence (including all presumptions and proof) and the regularity of the proceedings are governed by the rules of criminal law. The information must be strictly construed as well as the article alleged to be contemptous,» and the court further savs «the defendant is presumed to be innocent until proved guilty beyond a reasonable doubt, the same as a defendant in any criminal case. There are no presumptions taken against him, but the presumptions are all in his favor.» This is a wide departure from the attitude of those courts which seem to have presumed that their critics were guilty and to have thrown upon them the burden of proving the innocency of their intent. Certainly in contempt proceedings, where the offended judge sits substantially as accuser, judge and executioner, the rule announced is much more consonant with free press and free speech guarantees. The opinion handed down by the Supreme Court asserts «it is not the personal dignity nor the personal feelings of the court that justify contempt proceedings,» and that «attacks on the character or conduct of a judge as an individual may, in some cases, be so gross as to amount to a contempt,» but «only when they tend to influence the course of justice.» A most important holding of the court, especially at a time when the rights of free speech and free press have been so much clouded by voluntary and involuntary censorship and by so much public concern as to the effect of governmental control of many of the means of communication, is the reaffirmation of the principle that «under our theory of government the right of the freedom of speech and of the press are essential to public welfare.» While holding that these do not afford license to indulge in unwarranted attacks upon the courts, the opinion notes that «public opinion has greatly restrained the courts in the exercise of contempt powers, and that even false and unwarranted criticisms of judges affords them no greater remedy than those given to private citizens, unless they encroach upon the rights of litigants and tend to obstruct justice in pending matters or embarrass the judge in the discharge of judicial functions.» See LIBERTY OF THE PRESS; CENSORSHIP OF THE PRESS.

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PRESS ASSOCIATION OF LONDON, a subsidiary organization of the Reuter Agency, established in London in 1868 to furnish daily news to the povincial newspapers of the United Kingdom. See PRESS ASSOCIATIONS.

PRESS ASSOCIATIONS, organizations for the gathering and distribution of news. The association of newspapers for the collection of news began before the invention and use of the telegraph. In London the great dailies and other agencies supplied the interior press of the country with stereotyped news, and more especially with reports of the doings of Parliament; and in the United States, the shipping and other news, especially foreign, to be had at the Atlantic ports, was collected and distributed, by agencies, to subscribing newspapers, by fast boat and other means of transportation; and fast pony express was made use of for the conveyance of news from the national and State capitals to the larger and most important centres of population. A system of arbitrary signs was established at important harbors for the fast transmission of news to the great dailies. But the coming of the telegraph gave to these earlier news associations a sudden impetus which was destined to increase with wonderful speed. The great newspapers of New York City formed an association, in 1848, to pay jointly the expenses of the transmission, by telegraphy and other means, of comprehensive reports of the operations of the American forces in the Mexican War. Owing to the fact that the telegraph lines were then not extended throughout the South, the news was generally from a week to 10 days old when it appeared in print; but even with all this delay newspaper enterprise generally outstripped the government in the securing of early reports of war operations. The gradual extension of telegraph lines to the South rapidly widened the field of these early news-gatherers. The monthly news service of the Cunard Line between Europe and Boston was sent on to New York by wire; and from there it was transmitted to all parts of the country by various means of conveyance. With this European news went local market reports and other important information to the press of interior cities and towns. The rapid organization of the news features of the great cities followed; and to the current daily service were added full reports of happenings of general and national interest. The handling of news became a business of experts.

The Reuter Agency.— In the meantime Julius Reuter, a Prussian government messenger, conceived the idea of a great associated press service that could be extended to all papers desirous of making use of it. In 1849 he opened an office in Paris; but the French government discouraged him. This and the fact that the German government was rapidly extending its telegraph lines induced him to go to Aix-la-Chapelle where there was a gap between the telegraph line which ended there and the French-Belgian line terminating at Verviers. Reuter opened a news-collecting and distributing agency at each of these points and forwarded the news by carrier pigeon and other means of fast transmission. He extended his news service and finally removed his headquarters to London in 1851. This he had been induced to do owing to the fact that the Dover-Calais submarine cable had just been laid. Reuter's London office began the transmission of news by wire from London to Paris, at first, as correspondent for various newspapers on the Continent; for he had not been able to induce the great London dailies to purchase his news service. He used the wires wherever they existed and where they did not he employed special agents to transmit his news by carrier pigeon or fast messenger to all his subscribers. In his work of extending the news facilities of the press he overcame, by his tireless energy, countless difficulties, and soon the Reuter News Agency became known to every newspaper in Europe. Its first important conquest was the London *Morning Advertiser*, the second greatest newspaper in England in 1858. The *Times* and other British dailies soon fell into line and the Reuter Agency extended its news facilities still more rapidly than the rapidly extending telegraph lines. Reuter correspondents were to be found in all parts of the world. In 1866 Reuter connected Cork with Crookhaven by private submarine cable in order to be able to beat his competitors in furnishing news of the American situation. He also secured a concession for a submarine cable to Cuxhaven from the king of Hanover, and another for a cable between France and the United States, both in 1865. Reuter's Agency and the Anglo-American Telegraph Company made mutual use of this latter line. In 1868 the Press Association of London, a subsidiary affair, was formed to serve the provincial newspapers of the United Kingdom with daily news.

The Havas Agency.— Among the other news agencies that had already sprung into existence by this time were the Central News Agency, the Continental Agency, the Exchange Company, Dalziell's Cable News, the National Press Agency and the Havas Continental Agency. The oldest of these was the latter which dated back to 1835, when Charles Havas, a translator, opened an agency in Paris for the translation from English and Continental newspapers of interesting news for the French press. In 1840 Havas established a carrier pigeon news service between Paris, London and Brussels. This being the first attempt at the rapid transportation of news it naturally attracted much attention to the Havas Agency. Between this date and 1850 the name Havas became well known to the newspaper world, and more especially to the capitals of Europe; for the Havas Agency had kept abreast of the times and had made use of telegraph and railway transportation as rapidly as they had developed. Already, at this early date, Havas furnished daily news reports of a commercial, financial and political nature; and this had completely changed the nature of the news offered by the daily press. In 1856 the Havas Agency was amalgamated with the Bullier Advertising Agency; and among the patrons of the new concern were the foremost French dailies. Subagencies were opened in Madrid, Rome, Vienna, Brussels and, a little later, in various American cities. Working agreements were entered into with the Wolff Agency in Germany and the Reuter in London. This was followed by the planting of Havas correspondents in all the important news centres of Europe and America and in almost every town and city of any importance in France; for the Havas Agency has always made a specialty of local French news. It was the first to make use of the principle of the mutual exchange of news between a central news bureau and the newspapers taking its service. It was also the first to furnish syndicated material to subscribers in the form of special news features; and this part of the business it has developed very extensively. It furnishes *feuilletons* of a literary character, feature stories and novels written by the best-known and most popular of French writers. Fully 75 per cent of the typesetting of the French country press has been done away with through the «patent» material furnished it in the form of «mats» or stereotyped metal plates. Yet this local work has not prevented the Havas Agency giving much attention to the gathering of international news, a business which it has organized on a labor, money and time-saving basis. Special trained Havas correspondents are stationed in all the capitals and other great news centres of Europe, Asia and Africa; and whenever there is a sudden need for a correspondent the nearest Havas man is wired from Paris to go at once to the place where his services are required. All these correspondents are carefully educated in the ways of the agency and they know exactly what is expected of them. When it is necessary to depart from this routine they are so instructed by wire. The Havas Agency was the first to establish and perfect a very contracted figure and word code for the transmission by wire of routine news to countries to and from which the cable rates for news were excessively high. In 1879 Havas Agency was reorganized as a joint-stock company with a capital of $1,700,000, divided into 1,700 shares of $100 each.

The Wolff Bureau and the Oversea News Service became, in 1917, a part of the advertising machinery of the German government which purchased a controlling interest in each of them. To strengthen this strong news and advertising medium control was also secured of more than 50 per cent of the stock of some of the foremost daily papers in Germany and Austria. Among these were the *Deutsche Zeitung, Frankfurter Nachtrichten* and the *Lokal Anzeiger*. This new combination of news agencies also secured control of the greater part of the advertising patronage of Germany, and through this control of advertising it secured a powerful influence over the policy of the most important dailies in Austria.

The Associated Press of New York was organized prior to 1860, and the Western Associated Press was formed during the Civil War period. The latter was a strong cooperative organization, and for many years it was an important factor in the business of news gathering in this country. For 20 years the New York Associated Press and the Western Associated Press worked together in harmony. The wires of the Western Union Telegraph were utilized for transmitting reports, and thousands of miles of leased wires were constantly in use. In 1882 the United Press was formed, using the Postal Telegraph wires for the transmission of news, and in 1883 a third and smaller rival, the Press News Association, entered the field. Meanwhile dissensions arose over contracts between the New York and the Western associations, and the disputes were carried into the courts. The evidence showed that the Western Associated Press had made contracts for franchises between January 1883 and January 1893 with newspapers in the Far West, calling for payments under the contracts of $118,410. Of this amount the books showed that $85,294 had actually been paid in. One-half of this amount was claimed by the New York Associated Press as its share of the money collected from such sales of franchises. Suits and counter suits were commenced and the Western Associated Press was finally dissolved. A new Associated Press was organized under the laws of Illinois and for several years a close rivalry existed between this company and the United Press. Then dissensions arose and in 1900 the Associated Press was reorganized and reincorporated under the laws of New York State. In the meantime the Press News had died from financial mismanagement and soon afterward the United Press was wrecked. The Associated Press now began a prosperous career with no rival worthy of the name. The New York City Press Association, a local concern, was incorporated as a part of the Associated Press, which also began an exchange arrangement with Reuter's Agency in Europe. All the New York newspapers with the exception of the *Sun* received their foreign and domestic reports from the Associated Press. The *Sun* organized an independent news-gathering service, called the Laffan Bureau, and from the ruins of the

United Press co-operated with a number of newspapers between New York and San Francisco, thus building up a creditable organization independent of the Associated Press. A third organization, the Scripps-McRae Press (Western service) and the Publisher's Press (Eastern service) in 1903, was serving news to several hundred newspapers. These two companies, practically one, divide the eastern and western fields between them. The three press associations were strenuous rivals during the Spanish-American War, and special correspondents were sent with the American fleets and the armies in the field. Reporters were also stationed at every port on the Southern coasts. An Associated Press correspondent was with Dewey at the battle of Manila Bay. All three associations maintain resident correspondents in the larger American cities, and in London, Paris, Rome and the foreign capitals. Throughout the European War correspondents of the Associated Press were maintained at the front in France, where Reuter's, Havas and other news agencies were also represented either directly or indirectly. Correspondents were also maintained in all centres where war or important political news was to be had.

Newspaper Syndicate.— Closely allied with the press associations is the newspaper syndicate which instead of furnishing current daily news supplies special articles, correspondence, fiction and miscellaneous literary material to thousands of daily and weekly newspapers throughout the country. S. S. McClure was the pioneer in this field, followed by the American Press Association, the Bacheller and Johnson syndicate, the A. N. Kellogg Newspaper Union, the Leslie Syndicate, the Bulletin Press Association and numerous others. The syndicate is enabled, by its sales of the same article to many customers, to purchase matter quite out of the reach of the individual newspaper, and to sell it on terms that each can afford. The scheme is found to be so advantageous that practically all the leading newspapers use syndicate matter to a considerable extent. Besides the firms engaged primarily in the syndicate business, several leading metropolitan daily newspapers, notably the New York *Herald* and the *American*, dispose of their own matter to papers published in other cities. In addition to these there are now in the United States news syndicates for almost every kind of newspaper enterprise. If one wishes to start a local magazine, for instance, he can secure 32, 64 or 96 pages of material already printed and ready to bind in handsome cover, with or without advertising, at a very nominal price, if he publish the advertising; and all that is necessary is to add a few pages of local to have a finely printed and illustrated publication.

J. H. CORNYN.

PRESS CENSORSHIP. See CENSORSHIP OF THE PRESS.

PRESS-GANG, the name given in England to a detachment of seamen who (under the command of a naval officer) were empowered, in time of war, to take any seafaring men and oblige them to serve on board the king's ships. Consult Fletcher, W. J., 'The Press-Gang' (in 'The 19th Century and After,' Vol. L, p. 761, London 1901). See IMPRESSMENT.

PRESSBURG, prĕs'boorg, or **PRESBURG** (Magyar, *Pozsony*), Czecho-Slovakia, (1) free city in the west, capital of a county of the same name, on the left bank of the Danube, 35 miles east of Vienna. The site of the town is remarkably fine, being in the form of a semi-circle, bounded on the south by the Danube, from the banks of which it gradually ascends to the west and north toward ramifications of the Carpathians; and an extensive plain, covered with gardens, vineyards, meadows and corn-fields, forms its boundary on the east. The houses are built of brick and stone, and of two or three stories. The edifices most deserving of notice are the Landhaus, or Hall of the Diet, in which the chambers of the kingdom used to meet, but now used as a courthouse; the cathedral, a huge Gothic pile with a lofty steeple, begun in 1090, consecrated in 1452 and rebuilt in 1845–67, less remarkable as a church than as the place where the kings of Hungary were formerly crowned; a number of churches and monasteries, the Jesuit church, a synagogue, the city hall, begun in 1288, theatre, archbishop's palace, orphan hospital and barracks. The city possesses a number of interesting monuments, fountains and bridges. The old castle, formerly residence of the king of Hungary and located on a rock about 275 feet above the Danube, is now a ruin. Of educational institutions there are a law school, gymnasiums for boys and girls, a military academy, Protestant and Catholic lyceums and a well-equipped library. The industrial establishments are devoted especially to the manufacture of wooden ware, musical instruments, gloves, tobacco, silk ribbons, alcohol and woolens. There are also flour and sawmills and, in the suburbs, a sulphur factory and slate quarries. The trade, chiefly in corn, is extensive. Outside the town there used to be an artificial mound called the Coronation Hill, to which the newly-crowned kings of Hungary rode in grand procession and brandished the sword of Saint Stephen toward the north, south, east and west, signifying thereby that they undertook to defend the kingdom from danger, come from which quarter it might. Pressburg is a place of very great antiquity, being first mentioned in the 9th century. In 1541, when the Turks captured Buda, it became the capital of Hungary, till the Emperor Joseph II restored this dignity in 1784 to Buda. Pressburg, however, continued to be the seat of the Diet until 1848. The peace by which Austria ceded Venice to France and the Tyrol to Bavaria was concluded here in 1805. Soon after the establishment of this new republic of Czecho-Slovakia, the name of the city was changed to Bratislava. Pop. 78,223, of which 32,790 are Germans, 31,700 Hungarians and 11,600 Slovaks; 59,200 are Roman Catholics, 10,500 Protestants and 8,200 Jews. (2) The county of Pressburg, area, about 1,700 square miles, is traversed by part of the Carpathian chain in the north; in the south it is flat and fertile. It is watered by the Danube, March and Waag, and yields corn and grapes. The large forests furnish abundance of timber. Pop. 389,750. Consult Kiraly, J., 'Geschichte des Donau-Mauth- und Urfahrt-Rechtes der Freistadt Pressburg' (Pressburg 1890); Ortvay, T., 'Geschichte der Stadt Pressburg bis 1526'

(6 vols., Pressburg 1892–1903); ‘Pressburg's Strassen und Plätze’ (Pressburg 1905).

PRESSED GLASS. See Glass, Varieties of.

PRESSENSÉ, Edmond Dehault de, ĕd-môṅ dė-ōlt dė prā-sŏṅ-sā, French Protestant theologian: b. Paris, 3 June 1824; d. there, 8 April 1891. He studied theology under Vinet, Tholuck and Neander and in 1847 was appointed pastor of the independent Chapelle Taitbout in Paris. Throughout his whole career he was an eloquent opponent of the connection of church and state and an able supporter of evangelical Christianity. He also took part in politics, in 1871 was elected to the National Assembly by the department of the Seine, and thenceforward constantly sought to consolidate the republic on a thoroughly liberal basis. He was elected a life senator in 1883. He founded the *Revue Chrétienne* in 1854 and conducted it till his death. In spite of his many activities he found time for the publication of a large number of works: ‘Du Catholicisme en France’ (Paris 1851); ‘Histoire des trois premiers siècles de l'Église Chrétienne’ (6 vols., Paris 1858–77; new ed., 3 vols., Paris 1888–89); translated by Harwood-Holmden, A., as ‘The Early Years of Christianity’ (2 vols., London 1877–78); ‘L'Ecole Critique et Jésus-Christ’ (Paris 1863); translated by L. Corkran as ‘The Critical School and Jesus Christ’ (London 1865); ‘L'Église et la Révolution Française’ (Paris 1864); translated by J. Stroyan as ‘The Church and the French Revolution’ (London 1869); and by J. P. Lacroix as ‘Religion and the Reign of Terror’ (New York 1869); ‘Le pays de l'evangile’ (Paris 1864); translated as ‘The Land of the Gospel’ (London 1865); ‘Jésus-Christ, son temps, sa vie, son œuvre’ (Paris 1865); translated by Harwood-Holmden, A., as ‘Jesus Christ: His Times, Life and Work’ (London 1866); ‘Études évangéliques’ (Paris 1867); ‘Rome and Italy at the Opening of the Œcumenical Council’ (translated by George Prentice, New York 1870); ‘Le concile du Vatican, son histoire et ses conséquences politiques et religieuses’ (Paris 1872); ‘La liberté religieuse en Europe depuis 1870’ (Paris 1874); ‘Études contemporaines’ (Paris 1880); translated by Harwood-Holmden, A., as ‘Contemporary Portraits’ (London 1879); ‘Les Origines’ (Paris 1883); translated by Harwood-Holmden, A., as ‘A Study of Origins’ (London 1883); ‘Variétés morales et politiques’ (Paris 1885); ‘Les Énglises Libres de France et la reforme française du XVIe siècle’ (Paris 1887); ‘Alex. Vinet, d'après Sa Correspondance inédite’ (Paris 1890). Of his sermons quite a number have also been published, the most important of which are ‘Le Rédempteur, etc.’ (Paris 1854); translated as ‘The Redeemer’ (Edinburgh 1864); ‘Discours religieux’ (Paris 1859); ‘The Mystery of Suffering and other Discourses’ (translated by A. Harwood-Holmden, London 1868); ‘Le devoir’ (Paris 1875). Consult Loyson, H., ‘Edmond de Pressensé’ (Paris 1891); Roussel, Th., ‘Notice sur la vie et les Œuvres de Pressensé’ (Paris 1894); Thieme, H. P., ‘Guide Bibliographique de la Littérature Française’ (pp. 324–325, Paris 1907).

PRESSURE. See Force; Power.

PRESSURE FIGURES, *in mineralogy,* are certain radiating lines developed by the pressure of a point on a crystal or cleavage surface. They are diagonal to the percussion figures.

PRESTAGE, Edgar, English litterateur: b. Manchester, 20 July 1869. He was educated at Radley School, Abingdon, and Balliol College, Oxford. In 1902–08 he was engaged as law student and solicitor and at different periods was special lecturer in Portuguese literature at the University of Manchester, examiner in Portuguese to the universities of Manchester, London, Liverpool, Leeds and Sheffield and the civil service commission. He is corresponding member of the Lisbon Academy of Sciences, the Institute of Coimbra, etc., and commendador of the Portuguese order of São Thiago. Mr. Prestage's works are ‘Cincoenta documentos ineditos relativos a D. Francisco Manuel de Mello’; ‘Cartas de D. Francisco Manuel de Mello escriptas a Antonio Luiz de Azevedo’; ‘Portuguese Literature to the End of the XVIII Century’; ‘Registo da Frequesia de Santa Cruz do Castello de Lisboa’; ‘Letters of a Portuguese Nun’; ‘Sixty-four Sonnets of Quental’; ‘Short Stories,’ and contributions to encyclopedias and periodicals.

PRESTER JOHN (Priest or Presbyter John), a semi-legendary character of the Middle Ages. It was reported by travelers that there was a Christian prince who reigned in the interior of Asia under his name, and the same story was also known to the Crusaders. Albert of Aix and Otto of Freisingen speak of him in the 12th century; the Franciscan Rubruquis, in the 13th, attributes the name of Prester John to a Nestorian prince, Ung Khan, who had reigned in Karakoram over two Mongol tribes and perished in a war against Genghis Khan, above half a century before the time of his journey. Other travelers of the 13th century also mention this personage. Who this Prester John was cannot be determined. The supposition that he was one of the chief priests of the Lamaites does not agree with the position assigned to his residence by the travelers, nor do any etymological explanations seem satisfactory. The Portuguese in the 15th century, hearing a story of the Christian prince in the interior of Africa, whose name was Ogan, and who was in fact the negus (king) of Abyssinia, and being misled by the resemblance of the names Ogan and Ung Khan, made the mistake of transferring the throne of Prester John from Asia to Africa and giving the name to the Abyssinian prince. Consult Baring-Gould, S., ‘Curious Myths of the Middle Ages’ (2 vols., London 1867–68); Brunet, G., ‘La Légende du Prêtre-Jean’ (Bordeaux 1877); Hakluyt Society, ‘The Book of Sir Marco Polo’ (2 vols., London 1874); Oppert, G., ‘Der Presbyter Johannes in Sage und Geschichte’ (2d ed., Berlin 1870); Yule, Sir Henry, ‘Cathay and the Way Thither’ (2 vols., London 1866); Zarncke, F., ‘Der Priester Johannes’ (in ‘Abhandlungen der Koenigl. Saechsischen Gesellschaft der Wissenschaften,’ Vols. XVII and XIX, Philologisch-Historische Klasse, Vol. VII, pp. 827–1030, Vol. VIII, pp. 1–186, Leipzig 1879–83).

PRESTON, Ann, American physician and educator: b. West Grove, Pa., 1 Dec. 1813; d. Philadelphia, Pa., 18 April 1872. She was the daughter of Amos Preston, a Quaker, and her first knowledge of medicine was gained in many years of care for an invalid mother. Upon the opening of the Women's Medical College of Philadelphia in 1850 she enrolled as a student and was graduated in 1852. She engaged in practice in Philadelphia, achieving marked success, and in 1854 she became professor of physiology and hygiene at her alma mater, occupying the office of dean after 1866. She was instrumental in the establishment of the Woman's Hospital in Philadelphia, which she later served as consulting physician. Her lectures and addresses were strikingly able, and her defense of her sex as medical practitioners when in 1867 the Philadelphia County Medical Society decided to make public objection to them resulted in a reversal of the decision. She wrote several essays on medical education for women and was author of a volume of verse, 'Cousin Ann's Stories for Children' (1848).

PRESTON, Harriet Waters, American translator and novelist: b. Danvers, Mass., 6 Aug. 1836; d. Cambridge, Mass., 3 June 1911. At an early age she became noted as a linguist and has since achieved a brilliant reputation as a translator from the Latin and Provençal languages and as an essayist. Much of her work was published in the *Atlantic Monthly*. Her translations comprise Count de Falloux's 'Life and Letters of Madame Swetchine' (1867); Mistral's 'Miréio' (1873); C. A. Sainte-Beuve's 'Memoirs of Madame Desbordes Valmore' (1873); Paul de Musset's 'Biography of Alfred de Musset' (1877); C. A. Sainte-Beuve's 'Portraits of Celebrated Women' (1880); Virgil's 'Georgics' (1881); F. M. A. de Voltaire's 'Contes de Voltaire' in 'Oxford Modern French Series' (1912). Of her own original works the following have been published: 'Aspendale' (1871); 'Love in the 19th Century' (1873); 'Is That All?' (1876); 'Troubadours and Trouveres, New and Old' (1876); 'A Year in Eden' (1887); with Louise Dodge, 'The Guardians' (1888); and 'The Private Life of the Romans' (1893).

PRESTON, John Smith, American politician and soldier: b. near Abington, Va., 20 April 1809; d. Columbia, S. C., 1 May 1881. He was a younger brother of William Campbell Preston (q.v.) and was graduated from the Hampden-Sidney College in 1824, studied at the University of Virginia and at Harvard, and after an extended tour of Europe settled in Columbia. He was a member of the South Carolina legislature in 1848–56 and gained a high reputation as an orator. He openly and ardently upheld the secession movement, headed his State's delegation to the Charleston Convention in 1860, and in the following year became one of the commissioners to Virginia, where he made a brilliant speech, urging secession upon that State. He served in the Confederate army throughout the entire war. He was engaged at the first battle of Bull Run and afterward was assigned chief of the conscription department with the rank of brigadier-general. After the war he lived in Europe for a time, and after his return to the United States remained a bitter opponent of the government until his death.

PRESTON, Margaret Junkin, American author: b. Milton, Pa., 19 May 1820; d. Baltimore, Md., 28 March 1897. She was the daughter of George Junkin (q.v.), a well-known Presbyterian clergyman, who in 1829 moved with his family to Germantown, Pa., and in 1832 to Easton, Pa., where he became the first president of Lafayette College (q.v.). From 1841–44 she lived at Oxford, Ohio, where her father had moved after accepting the presidency of Miami University. In 1844 he became once more president of Lafayette College, necessitating the removal of his family again to Easton. In 1848 her father accepted the presidency of Washington College, now Washington and Lee University, at Lexington, Va., at which place the family continued to reside from then on. In 1857 she was married to John T. L. Preston, one of the founders and a member of the faculty of the Virginia Military Institute. Later on he served on the staff of Stonewall Jackson, who had married Mrs. Preston's younger sister. Mrs. Preston continued to reside in Lexington until 1892, two years after her husband's death. She then moved to Baltimore, Md., where until her own death she made her home with her oldest son. In 1855 she translated the Latin hymn 'Dies Iræ' and in 1856 published her first book, a novel entitled 'Silverwood.' Her subsequent work is almost entirely in verse and is characterized by deep religious feeling and an ardent espousal of the Confederate cause. She published 'Beechenbrook; a Rhyme of the War' (Baltimore 1866); 'Old Songs and New' (1870); 'Cartoons' (Boston 1875); 'Centennial Poem for Washington and Lee University, Lexington, Va., 1785–1885' (New York 1885); 'For Love's Sake' (1886); 'A Handful of Monographs, Continental and English' (New York 1886); 'Colonial Ballads, Sonnets and Other Verse' (Boston 1887); 'Semi-Centennial Ode for the Virginia Military Institute, Lexington, Va., 1839–89' (New York 1889); 'Chimes for Church Children' (Philadelphia 1889); 'Aunt Dorothy; An Old Virginia Plantation Story' (New York 1890). Her diary, giving an interesting and valuable history of her life in the South, is published in part in Elizabeth Preston Allan's 'Life and Letters of Margaret Junkin Preston' (Boston 1903). Consult also Picket, L. C., 'Literary Hearthstones of Dixie' (Philadelphia 1912).

PRESTON, Thomas Scott, American Roman Catholic clergyman: b. Hartford, Conn., 23 July 1824; d. New York, 4 Nov. 1891. He was graduated from Washington (now Trinity) College in 1843, from the General Theological Seminary of the Protestant Episcopal Church in 1846 and held assistant rectorates in New York. In 1849 he entered the Roman Catholic Church, and after study at Saint Joseph's Seminary, Fordham, N. Y., was ordained priest in 1850. He became chancellor of the archdiocese of New York in 1853, and in 1863 rector of Saint Ann's, New York. In 1872 he was made vicar-general of the New York archdiocese, in 1881 he was made monsignor and in 1888 prothonotary apostolic. He vigorously opposed the land and labor movement of Henry George (q.v.) and was active in urging the excommunication of Dr. McGlynn (q.v). He founded and for many years directed the Sisters of the Divine Compassion. As a preacher he enjoyed considerable popularity. Among his many controversial and devotional works are 'The Ark of the Covenant; or, A Series of Short Discourses Upon the Joys, Sorrows, Glories and Virtues of the Ever Blessed Mother of God' (New York 1860); 'The Life of Saint Mary Magdalene' (New York 1860); 'The Life of Saint Vincent de Paul' (New York 1866); 'Lectures on Christian Unity' (New York 1867); 'Lectures on Reason and Revelation' (New York 1868); 'Christ and the Church' (New York 1870); 'Vicar of Christ' (New York 1878); 'The Divine Paraclete' (New York 1879); 'The Protestant Reformation' (New York 1879); 'Protestantism and the Bible' (New York 1880); 'Christian Unity' (New York 1881); 'Protestantism and the Church' (New York 1882); 'God and Reason' (New York 1884); 'The Sacred Year' (New York 1885); 'The Watch on Calvary' (New York 1885); 'The Divine Sanctuary' (New York 1887); 'Gethsemane' (New York 1887). Consult Brann, 'The Rt. Rev. Thomas S. Preston, Vicar General' (New York); Preston, 'Remembrances of My Brother Thomas.'

PRESTON, William, soldier, lawyer: b. near Louisville, Ky., 16 Oct. 1806; d. Lexington, Ky., 21 Sept. 1887. He was educated at the Harvard College Law School, from which he was graduated in 1838. He then entered upon the practice of law in Kentucky and took much interest in politics. During the Mexican War he served as lieutenant-colonel of a Kentucky regiment. In 1851 he was a Whig representative in the Kentucky legislature, but when the Whig party broke up he became a Democrat. During Buchanan's administration he was Minister to Spain. He returned to America in time to see the beginning of the Civil War. In 1861-62 he was colonel on the staff of Albert Sidney Johnston. In 1862 he was made brigadier-general. He was engaged in the campaigns of the Western army, notably at Vicksburg, Baton Rouge, Murfreesboro and Chickamauga. In 1864 he was sent to the Trans-Mississippi Department and in 1865 was made major-general. After the war he settled in Lexington, where he practised law until his death. In 1867 he was a member of the Kentucky legislature and in 1880 a delegate to the National Democratic Convention.

PRESTON, William Campbell, American legislator and educator: b. Philadelphia, Pa., 27 Dec. 1794; d. Columbia, S. C., 22 May 1860. He was graduated from the South Carolina College in 1812, studied law and was admitted to the bar in 1820. He established a law practice in Columbia, S. C., in 1823, and speedily became prominent in his profession, excelling as a jury lawyer. He sat in the State legislature in 1828 and in 1830-32, where he boldly advocated nullification and won a high reputation as an orator. In 1833 he was elected to the United States Senate, but refused to act with his colleague, Calhoun, in the latter's support of Van Buren, and resigned his office in 1842. In 1845-51 he was president of the South Carolina College and a trustee of it from 1851 to 1857 and proved an able and successful administrator. He established the Columbia Lyceum, which he endowed with his own library of 3,000 volumes. Consult Miller, W. L., 'William Campbell Preston' (in *The Green Bag*, Vols. XI and XII, Boston 1899-1900); O'Neall, J. B., 'Biographical Sketches of the Bench and Bar of South Carolina' (Charleston 1859).

PRESTON, Canada, town in Waterloo County, Ontario, at the confluence of the Speed and Grand rivers, 55 miles, direct, southwest of Toronto, on the Grand Trunk and Canadian Pacific railways. It is an outport for Ontario and has flour and saw mills as well as manufactories of iron castings, woolens, shoes, furniture, piano-players and other industries, including machine shops. The population is steadily increasing. Pop. 3,882.

PRESTON, England, an important manufacturing town of Lancashire, 28 miles northeast of Liverpool, on a height above the north bank of the Ribble, near the head of its estuary, and on the London and North-Western and the Lancashire and Yorkshire companies railways. The river is spanned by five bridges. The handsome central railway station cost about $1,000,000. Other important buildings are the Gothic town-hall; courthouse, in the Doric style; a new infirmary, the house of correction, the custom-house, corn-exchange, new gas offices, large and handsome market-shed, extensive barracks, workhouse, theatre and assembly-rooms; the Literary and Philosophical Institution, provided with a library and museum; the Harris Institute of Literature, Art, Science and Technical Instruction (formerly the Mechanics' Institute, and now greatly enlarged); The Free Public Library and Museum, in the Grecian style, with many valuable paintings, etc. The ecclesiastical edifices include a number of Established churches, beside Roman Catholic and other chapels. Among the former Christ Church is admired for the purity of its Norman architecture; and the parish church, which has been rebuilt in the decorated style of the 14th century, with a spire 196 feet high, is also a fine building. Saint Walburge's Roman Catholic Chapel, which has a beautiful spire 306 feet high, ranks as the most splendid place of worship in Preston. The town is supplied with water from reservoirs situated near Longridge, 18 miles northeast of Preston. with a capacity of 405,000,000 gallons. On the south side of the town are two beautiful public parks, and on the north side is the Moor Park. The original staple manufacture of the town was linen, which is still woven, but has been completely eclipsed by the cotton manufacture, especially spinning, first introduced in 1777. There are engineering works, machine-shops, iron and brass foundries, boiler works, breweries, malt-houses, roperies, tanneries, etc. A considerable shipping trade is carried on, though it was long obstructed by the condition of the Ribble. Since 1884 the river has been canalized and large docks have been built and a very considerable increase in the trade has taken place. Preston and Lancaster are connected by canal.

Preston is said to have risen on the decay of Ribchester, the Roman Rigodunum, situated about 11 miles farther up the river. Its name, originally Priest's town, it owed to the number of religious houses which it contained. About 600 it was a Saxon settlement; in 1322 it was taken and burned down by Robert Bruce; in the great Civil War it espoused the Royalist cause, and suffered severely during the contest, having been twice captured by the Parliamentarians, who on the latter occasion were headed by Cromwell in person; in the rebellion of 1715 it was occupied by the Jacobite forces, who erected barricades and made a brave resistance, but were ultimately obliged to surrender. Modern Preston is a Parliamentary borough, returning two members. Its municipal government is in the hands of a mayor, 12 aldermen and 36 councillors. Pop. about 117,113. Consult Clemesha, H. W., ‹A History of Preston in Amounderness› (in ‹Publications of the University of Manchester, No. 67, Historical Series No. 14,› Manchester 1914); Fishwick, H., ‹History of the Parish of Preston› (Rochdale 1900); Whittle, P., ‹History of the Borough of Preston› (2 vols., Preston 1837).

PRESTONBURG, Engagements at and near. In September 1861 Col. John S. Williams began to organize a Confederate force at Prestonburg, in eastern Kentucky, to operate in the interior of the State. On 8 November Gen. William Nelson, who had advanced against him with three Ohio regiments, detachments of Kentucky infantry and cavalry and two sections of artillery, with a part of this force encountered a detachment thrown forward by Williams to cover his withdrawal. After a well-contested engagement at Ivy Mountain, Williams was forced from his position and retreated through Pound Gap into Virginia, with a loss of 10 killed, 15 wounded and 40 missing. Nelson was recalled to Louisville, and Williams returned to Prestonburg. Gen. Humphrey Marshall had been ordered, 1 November, to the command of the Confederate forces in eastern Kentucky, including those of Williams, and soon had in addition two Virginia regiments and a battery of four guns, making a total force of about 2,400 men, who were badly clothed, many of them barefooted, and generally badly armed, many of the men having only shotguns and squirrel-rifles. In the beginning of January 1862 Marshall had the greater part of his command intrenched near Paintsville, on the main branch of the Big Sandy River, a few miles north of Prestonburg. On 17 December General Buell assigned Col. James A. Garfield to the command of a brigade of about 3,000 men, partly cavalry, and sent him against Marshall and to clear the valley of the Big Sandy. On the 23d, when Garfield began his march up the course of the river, the greater part of the brigade was concentrated at Louisa, on the Big Sandy. On 6 Jan. 1862, after driving in several scouting parties, Garfield arrived within seven miles of Paintsville. Marshall, well informed of his approach, fell back from Paintsville on the night of the 5th to the forks of Middle Creek, about three miles above Prestonburg. Garfield advanced through Paintsville, defeated Marshall's cavalry at the mouth of Jennis' Creek on the 7th, and on the morning of the 10th attacked Marshall on Middle Creek with cavalry and was repulsed by artillery alone. Garfield now attacked with infantry and the fight continued from noon to near dark with varying success, several Union advances being repulsed; but Marshall finally abandoned his position, though not retiring from the field until next morning, when, being out of food for his men, he marched to Martin's Mill. Garfield did not pursue. He crossed the river on the 11th and occupied Prestonburg, and on the 12th and 13th withdrew to Paintsville. Both sides claimed the victory. Garfield had 1,700 men on the field, and his loss was two killed and 25 wounded. Marshall had 1,500 engaged, and lost 11 killed and 15 wounded. Consult ‹Official Records› (Vol. VII); The Century Company's ‹Battles and Leaders of the Civil War› (ed. by R. U. Johnson and C. C. Buel, Vol. I, New York 1887); ‹War of the Rebellion: Compilation of Official Records of the Union and Confederate Armies› (Series 1, Vol. VII, p. 21; Vol. XX, Pt. 1, p. 31; Vol. XXI, p. 1065; Washington 1882–88).

PRESTONPANS, prĕs-tŏn-pănz', Scotland, a small town in Haddingtonshire, on the Firth of Forth, nine miles east of Edinburgh, celebrated for the battle fought in the vicinity, 21 Sept. 1745, when the Highlanders, headed by Prince Charles, defeated the royal troops commanded by Sir John Cope. Pop. 1,923. Consult M'Neil, P., ‹Prestonpans and Vicinity› (Tranent 1902).

PRESTWICH, Sir Joseph, English geologist: b. London, 12 March 1812; d. Shoreham, Kent, 23 June 1896. He spent one year at University College, London, continued his geological studies though at the age of 18 he entered his father's office and for many years he was a prominent wine merchant. The Geological Society conferred a medal upon him in 1849, and he received like honors from the Royal Society in 1865. In 1864 he became a member of the Water Commission and in 1866 of the Royal Coal Commission. In 1870 he became president of the Geological Society and in the same year married. In 1872 he retired from business. He became professor of geology at Oxford 1874 and though advanced in years for the adoption of a new profession his vast learning and the vigor with which he approached his new task enabled him to fill the position with great success. His most important researches relate to the Tertiary deposits, which he rearranged and reclassified, and evidences concerning the existence of the prehistoric man. He also applied his knowledge to the practical question of obtaining from underground waters a better supply for cities. He retained his professorship at Oxford until 1888, was connected with various important scientific societies and in 1896 was knighted. He was a Fellow of the Geological Society, the Royal Society, the Chemical Society, the Geological Society of France, an associate of the Institute of Civil Engineers and an honorary and corresponding member of a number of English and foreign scientific societies. Oxford University gave him the degree of D.C.L. in 1888. His writings reached the large number of 140. Of these the following were published in book form: ‹A Geological Inquiry respecting the Water-bearing Strata of the Country around London, etc.› (London 1851; new ed., 1895); ‹The Ground beneath Us: Its Geological Phases and Changes, etc.› (London 1857); ‹An Index Guide to the Geological Collections in the University Museum, Oxford› (Oxford 1881); ‹Geology, Chemical, Physical and Stratigraphical› (2 vols., Oxford 1886–88); ‹Collected Papers on Some

Controverted Questions in Geology' (London 1895); 'On Certain Phenomena Belonging to the Close of the Last Geological Period, and on their Bearing upon the Tradition of the Flood' (London 1895). The balance of his writings was published in scientific journals and magazines. Consult Lady Prestwich, 'Life and Letters of Sir Joseph Prestwich' (Edinburgh 1899).

PRESUMPTION, *in law,* is a supposition held as good or real before it is shown or certainly known to be so. Presumptions are either *juris,* or *juris et de jure.* A legal presumption in law is one established in law till the contrary be proved. Thus, a person who has the possession of goods is presumed to be the owner, or a man is assumed to be innocent unless the contrary be proved. Presumptions are adopted from the necessity of arriving at some conclusion or other in most cases where the evidence is general or inconclusive. Thus, where a person has disappeared and has not been heard of, the law will in general presume that he is still alive, unless after a lapse of time considerably exceeding the ordinary duration of human life; but if there be evidence of his continuous unexplained absence from home, and of the nonreceipt of intelligence concerning him for a period of seven years, the presumption of life ceases.

PRETENDER, The. See STUART, JAMES FRANCIS EDWARD.

PRETENDER, The Young. See STUART, CHARLES EDWARD.

PRETORIA, prę-tō'ri-ą, South Africa, administrative capital of the Union of South Africa (q.v.) and the province of the Transvaal (q.v.), situated on the banks of the small river Aapies, a tributary of the Limpopo, 4,500 feet above sea-level, 46 miles northeast of Johannesburg, 349 miles by rail west of Delagoa Bay and 1,003 miles by rail northeast of Cape Town. The town is regularly laid out and many of the streets are planted with splendid willow trees. The most important public buildings are the government buildings, in Church Square, surmounted by a statue of Liberty; the post office; the Dutch Reformed church, formerly in the centre of Church Square, destroyed in 1905; the Anglican cathedral of Saint Alban; a Roman Catholic church, with school and convent buildings; a new Dutch Reformed church; the former presidency and residence of the late Paul Kruger (q.v.); the Jewish synagogue, a handsome building; the new market buildings; the law courts; a public library, containing English and Dutch books; the National Museum adjacent to the Zoological Gardens; a new opera-house. Pretoria, since 1916, is the administrative seat of the newly constituted University of South Africa, consisting of six colleges in various parts of the Union with a total of 87 teachers and 560 students in 1915–16. The town is lighted by electricity, and public waterworks were opened in 1891. Just outside the town are the barracks, and near them the prison is situated. In 1896 the Boer authorities began the construction of a circle of six forts round the town, which since the Boer War have been dismantled. Pretoria was founded in 1855, and was named in honor of Andries Pretorius, the first President of the South African Republic. In 1864 it replaced Potchefstroom as the seat of the central administration. In December 1880 the British garrison in Pretoria was besieged by a force of Boers, and on the retrocession of the country in the following year the town was evacuated by the British troops. The gold-rush which began about 1886, and the working of the natural wealth of the neighboring Witwatersrand, had a great influence upon the condition of Pretoria, which was rapidly improved in respect of architecture and sanitation. On 5 June 1900 the town was occupied, practically without opposition, by a British force under Lord Roberts, after President Kruger, who had for many years been the dominant figure of the town, had fled in May, and then became the headquarters of the British operations in the South African War (q.v.). It was at Pretoria that on 31 May 1902 the peace articles were signed. In 1907 the first Parliament of the Transvaal (q.v.), which by that time had become a self-governing part of the British Empire, met at Pretoria. It was later displaced by a Provincial Council. Since 1903 Pretoria is a municipality, controlling its sewers, water and electric-light systems, as well as its trolley lines. There are a number of attractive suburbs, in one of which, Bryntirion, is located Meintjes Kop which has become the site for the public offices of the Union. In the cemetery at the western end of the town are buried Paul Kruger and many of the British who fell in the Boer War. Nearby is also the big new Central Railway station and workshops. The world-famed Premier Diamond Mine is about 30 miles northeast of Pretoria. The population, which before the war was about 12,000, has increased to over 29,618. Consult Berthold, H., 'Pretoria, die Hauptstadt des Neuen Suedafrika' (in 'Zeitschrift für Kolonialpolitik, Kolonialrecht, und Kolonialwirtschaft' (Vol. II, pp. 826–835, Berlin 1909); Hillegas, H. C., 'Pretoria Before the War' (in *Harper's New Monthly Magazine,* Vol. C, pp. 548–557, New York 1900); 'Pretoria. News of the Camp. A Journal Published in the Military Camp of Her Majesty's Forces Defending Pretoria, 25 Dec. 1880 to 9 April 1881' (ed. by C. Du-Val and C. Decker, Pretoria 1880–81).

PRETORIUS (Dutch, prā-tō'ri-ŭs), **Marthinas Wessels,** Boer soldier and politician: b. Natal, 1827; d. Potchefstroom, South Africa, 19 May 1901. He took part in the "Great Trek" of 1836, and in 1852 became commandant-general of the Boers. He made a name for himself in his capacity as commander of the forces making war upon the Kafirs, and shortly afterward (in (1860) he was elected President of the Orange Free State; in 1864 of the South African Republic. Re-elected in 1869, he soon afterward resigned. After the Boer trouble in 1877 and following years Pretorius formed part of the provisional Transvaal government in 1880. After Kruger's election in 1883, Pretorius took small part in the affairs of the republic, being persistently opposed to the war policy against Great Britain as destined eventually to subvert the independence it sought to secure. Pretoria, the capital of the Transvaal, was named in his honor.

PREVENTIVE MEDICINE. Generally the term "preventive medicine" has been regarded as almost synonymous with public hygiene and its application has been confined to the operations of the sanitary authorities in the prevention of the infectious and communicable diseases. These operations have not in the past included even all of the more important communicable diseases, although the list in recent years has been considerably extended. Formerly cholera, plague, yellow fever, typhus fever, epidemic dysentery, smallpox, scarlet fever, diphtheria and typhoid fever practically comprised all of the diseases which came specifically under the supervision of the public health authorities. Recently this list has been considerably increased by some sanitary boards. Many of the diseases referred to — for example, cholera, plague, yellow fever, epidemic dysentery — have practically passed from the supervision of the authorities, at least in the temperate zones, because either they no longer occur at all in these regions or only occasionally a case or a group of cases appears and calls for specific action and supervision. The eradication of these epidemic diseases may be regarded as the greatest triumph of preventive medicine. It will of course be noted that public hygiene or preventive medicine, in this restricted sense, has taken little or no cognizance as yet of many exceedingly important communicable diseases, such as syphilis, gonorrhœa, puerperal fever and, generally speaking, even of tuberculosis.

Preventive medicine in the proper sense has a very much broader scope than that indicated and may be defined as the sum of all medical knowledge applicable to the prevention of disease — of all disease in the broadest sense and not simply of the communicable diseases. It presupposes the widest knowledge of medicine and has its essential foundation in our knowledge of the anatomy and causation of disease. Preventive medicine comprises, therefore, the prophylaxis of disease; it is general, comprising those measures which are applicable to the prevention of disease in the community (including especially the communicable diseases), and it is individual, as applied to the prevention of disease of all kinds in the individual members of the community. General prophylaxis refers to what are spoken of as preventable diseases and these in the broad sense may be regarded as all of the infectious diseases which are communicable. Individual prophylaxis has a still wider scope and includes the whole sum of medical knowledge as applied to the prevention of diseases (of all varieties) and the prolongation of life. General prophylaxis and individual prophylaxis do not always run along wholly parallel lines; for what is best for the individual is not necessarily best for the community. Preventive medicine is an applied science and includes all purely medical knowledge applicable to the attainment of its aim. In securing its aim preventive medicine necessarily improves the general physical well-being of the individual and thus life is rendered not only longer, but happier.

General prophylaxis attains its purposes in different ways. Through the establishment of sea quarantine it attempts to exclude infectious diseases which are endemic. These are spoken of as "quarantinable diseases" and they of course must differ with locality, depending upon what communicable diseases are endemic in a locality. In the United States, plague, cholera, typhus fever, yellow fever and leprosy are the diseases which the authorities especially attempt to exclude from the country. Scarlet fever, measles, diphtheria and smallpox, being endemic, are not held at quarantine, but are referred to isolation hospitals for supervision until their termination. During recent years the quarantinable diseases have been almost completely excluded from this country. Occasionally a case has been admitted at some point and a group of cases or a localized epidemic has followed; but in almost all instances the outbreaks have been of a restricted and local character. It does not seem probable that in North America there will ever again be any serious danger of the prevalence of cholera, plague, typhus fever or leprosy. In dealing with the other communicable diseases specific methods have been devised, depending upon the nature of the disease and the method of its transmission. In some instances the attempt is made to destroy the cause or prevent its entrance into the body; in other instances, to render the individual insusceptible to the cause and at the same time protect him from exposure to infection. For example, the cause of smallpox not being known, it is vain to attempt to destroy it in the individual; but as vaccination renders a person insusceptible to smallpox, it proves an absolutely efficient means for preventing the prevalence of this disease. In cities and countries where vaccination and revaccination are enforced smallpox rapidly disappears, and even when cases are introduced from without, the disease does not extend. Thus in Prussia, where there is compulsory vaccination in infancy and revaccination at different intervals later in life, smallpox practically does not exist. In different portions of the United States the prevalence of smallpox in epidemic form is determined in each instance by the thoroughness with which different communities have been vaccinated. In the recent Great War less than a dozen deaths from smallpox took place in an army of 4,000,000 men.

In typhoid fever the methods followed in prevention are of a different character. The typhoid bacilli which cause typhoid fever are practically always taken into the body through the mouth, usually in drinking water or food. The commonest sources of infection are contaminated water, milk and oysters and also the direct infection of those in immediate contact with typhoid fever cases, by the transfer of the typhoid bacilli to the mouth on soiled hands or from eating or drinking utensils. Aerial infection plays a small part in the causation of this disease. The prevalence of typhoid fever has been very greatly restricted by the protection of the sources of water-supply, by the application of sanitary measures to the collection of milk, by proper disposal of sewage and in recent years by preventive inoculation, which, in large armies, have made what was a formidable disease almost non-existent. Sewage is the medium through which the typoid infection reaches the water-supply. Milk is infected, not when derived from the animal, but subsequently, from the washing of utensils with contaminated water or in some similar way. As yet no active measures have been adopted by the sanitary authorities to prevent the contamination of shellfish through the sewage-pollution of the water in which the shellfish beds are situated. This is probably a much more common source of infection than has been generally supposed. In the case of scarlet fever, measles, diphtheria, chickenpox, whooping-cough and mumps, prophylactic measures comprise the removal of the sick if possible to special isolation hospitals designed for this purpose and the adequate disinfection of clothing, rooms, furniture, bedding, etc., which may have become infected by contact with the sick. At present no other means are available, except in diphtheria, largely because of the lack of knowledge as to the exact causes of these diseases. In diphtheria, besides these measures, there is now a method for rendering the individual insusceptible to the disease for short periods by administering immunizing injections of diphtheria antitoxin. By these injections the individual may be rendered insusceptible to the disease (as in smallpox by vaccination), but the immunity is of short duration.

Many sanitary authorities are now adopting measures for the prevention of tuberculosis, which causes more deaths throughout the civilized world than any other single disease. Here again the problem of prophylaxis differs from that applicable to any of the other diseases mentioned. In tuberculosis the tubercle bacilli, which are the cause of the diseases, are solely contained in the discharges from the diseased tissues, but the only form of tuberculosis (the disease may affect any organ or tissue of the body) in which the discharges containing the tubercle bacilli are likely to be a source of danger to others is tuberculosis of the lungs or pulmonary consumption. In this form, tubercle bacilli are frequently present in the expectoration in almost incredible numbers. The prophylaxis of tuberculosis is, therefore, practically comprised in the destruction of the expectoration of persons suffering from pulmonary tuberculosis at the time of its exit from the body. If this could be absolutely accomplished the transmission of tuberculosis from one person to another would be almost completely avoided. A common source of infection is probably present in the minute drops of atomized expectoration which are forcibly discharged into the air in coughing and sneezing, unless the mouth and nose are covered during these acts. The prevention of tuberculosis only requires the exercise of scrupulous care with regard to the expectoration, the removal to isolation hospitals of those who are unwilling, too ignorant or unable because of weakness, to adopt proper precautions and the disinfection of rooms, with their contents, which have been occupied by tubercular patients. There remain to be considered, aside from this prophylaxis as applicable to the human being the measures necessary because of the possible transmission of the disease from animals, especially through the meat and milk of tubercular cows. But while this is a real danger, its importance has probably been greatly overestimated. It is now well known that tuberculosis very rarely exists at birth. It is never inherited, in the strict sense, and only in very exceptional instances does intra-uterine infection occur.

General prophylaxis has as yet scarcely touched upon many of the other infectious and probably, to some extent at least, preventable diseases. The venereal diseases have been ignored because the problem is so largely a social one. No preventive measures even promising in their character have been suggested for dealing with them. The prevalence of the puerperal diseases has been very largely reduced through individual prophylaxis at the time of childbirth.

The diarrhœal diseases of infancy are not as a rule properly to be regarded as communicable, but their prevalence has been greatly restricted through the work of health authorities in the sanitary control of milk and, to a less extent, of the water-supply. The reduction during recent years in the death-rate from diarrhœal diseases of children under two, which has taken place almost everywhere in this country, is almost phenomenal, and indirectly the reduced prevalence of these diseases has materially decreased others brought on by them — diseases of malnutrition, such as rickets, etc. The results which have thus been accomplished have been due almost entirely to increased medical knowledge and its intelligent application to preventive medicine.

Preventive medicine, however, in the truest, broadest and best sense, includes not only this work in the general application of medical knowledge to restricting the prevalence of the infectious diseases in the community, but also the application of medical knowledge to the protection of the individual from disease of all kinds at every stage in life from birth to old age, and it is this individual prophylaxis which has received the least attention either from the medical profession or from the people. Here is a very large field for intelligence work. A moment's consideration shows at once the impossibility of formulating general rules or of applying the same rules to all individuals, for it is a matter of common observation that individuals differ widely in their physical and mental characteristics, susceptibilities and tendencies. The occurrence in different families of certain similar types of disease in successive generations is a matter of general observation, and the influences which are injurious at one period in life may be not only not harmful but beneficial at another. It is most unfortunate, from this point of view at least, that the family physician of former times is so generally disappearing. The ideal family physician knew thoroughly the family histories of his patients, their tendencies, susceptibilities, weaknesses; he watched every stage in the life of the child from birth; he knew where to restrain, where to encourage and what to prohibit, where dangers to the physical well-being lay and how to advise them for self-protection. In earlier days when the knowledge of disease was less extensive than at present, it was not within the power of the physician to advise as wisely as at present. It is well known now that disease as such is never inherited. It is too much the custom to think of disease as a definite entity, whereas it is really only an abnormal process. It is not possible to see or examine disease, as it has no existence as such, but in some instances the causes of disease may be studied, as is the case in the infectious diseases due to known micro-organisms. In these may be investigated the micro-organisms causing the disease and the changes in the organisms produced by the germs; so also may be studied the abnormal manifestations of life which these changes produce, those manifestations, which are called the symptoms of disease. The so-called inherited diseases which are of an infectious nature are simply instances of infection during intra-uterine life, as tuberculosis and syphilis. The diseases of metabolism, such as gout, diabetes, adiposity, etc., are not instances of inherited disease, when they occur in different generations in the same family, as is frequently the case, but are the result of the transmission from parent to children of functionally inefficient organs, which break down under the demands laid upon them.

Among the more recent additions to general prophylaxis are the movements now actively going forward to prevent mental diseases. This whole movement of mental hygiene is one of the most important of modern times. While it has been recognized for years that a healthy mind can exist only in a healthy body, it is being more and more emphasized that there can be no healthy body without a sound mind.

An absolutely efficient prophylaxis applied to the individual would permit the conduct of a physiological life from birth to its termination in a physiological death, occurring when the vital resistance with which the individual was endowed at birth was exhausted. With advancing medical knowledge and a higher civilization there should be a closer approximation to this condition in a larger and larger percentage of the population and a material prolongation of the mean lifetime.

HERMANN MICHAEL BIGGS, M.D.,
New York State Public Health Commissioner.

PREVIOUS QUESTION, a question put to a parliamentary body with the object of suspending debate on the subject under consideration, the question being put upon a member's motion in order to ascertain if the assembly desire to vote upon the subject at once. The form of the question is: «Shall the main question now be put?» Any member may demand the previous question and if the vote be in the affirmative, the main question as ordered, whether a single motion or all the motions necessary to put the measures through all its stages to final passage, is put to a vote. If the previous question be ordered on a question on which there has been no debate, then 40 minutes of debate are permitted, but if there has been even a brief debate before the previous question is ordered, an immediate vote must follow the ordering of the previous question. The 40 minutes are divided equally between the supporters and opponents of the measure. In practice the member having charge of a measure and having the floor usually calls for the previous question at the end of his speech unless the measure is being debated under a special order. (See CLOSURE; PARLIAMENTARY LAW). Consult Hinds, A. C., 'Digest and Manual of Rules and Practice of the House of Representatives' (Washington 1908).

PREVOST, prĕ-vō', **Augustine,** English soldier: b. Geneva, Switzerland, about 1725; d. England, 5 May 1786. He entered the army, served under Wolfe at Quebec as captain of the 60th regiment. He was promoted to the rank of lieutenant-colonel in 1761, and four years later he was made commander of the troops in the Southern Department and was stationed at Pensacola, and in 1778 captured the fort at Sunbury, Ga., for which service he was brevetted major-general. He then commanded the forces which defeated Gen. John Ashe at Briar Creek in 1779, but failed in an attempt to capture Charlestown in that year. He distinguished himself by his successful defense of Savannah against the Americans and French in October 1779, and received full rank as major-general in recognition of his services. His son was Sir George Prevost (q.v.).

PRÉVOST, prā'vō', **Eugene Marcel,** French novelist: b. Paris, 1 May 1862. He was educated at the Polytechnic School in Paris and until 1891 he was engaged in tobacco manufacturing at Lille. His conceptions are clever and well worked out, his style easy and usually graceful, but his later work, though brilliant, shows a tendency to the delineation of morbid emotional types. His first book, 'Le Scorpion' (1887), attracted great attention from its attack on the Jesuit system of education). His later works include 'Chonchette' (1888); 'Mademoiselle Jaufre' (1889); 'La Cousine Laura' (1890); 'La confession d'un amant' (1891); 'L'Automne d'une femme' (1892); 'Lettres de femmes' (1893); Nouvelles lettres de femmes' (1893); 'Demivierges' (1894); 'Le moulin de Nazareth' (1894); 'Notre compagne' (1895); 'Le jardin secret' (1897); 'Dernieres lettres de femmes' (1897); 'L'Heureux ménage' (1901); 'Nimba'; 'Le mariage de Julienne'; 'Les vierges fortes' (1901); 'Lettres à Françoise' (1902); 'La pas relevé' (1903); 'La plus faible' (comedy 1904); 'La princesse d'Erminge'; L'Accordeur aveugle' (1905); 'Monsieur et Madame Moloch' (1906); 'Femmes' (1907); 'Lettres a Françoise mariée' (1908).

PREVOST, SIR **George,** English soldier, son of Augustine Prevost (q.v.): b. New York, 19 May 1767; d. London, England, 5 Jan. 1816. He entered the army in early youth, distinguished himself in the West Indes, was promoted major-general in 1805 and created a baronet later in the same year. In 1808 he was appointed lieutenant-governor of Nova Scotia and in the autumn of that year he conducted a division of troops to the West Indies where he participated in the capture of Martinique as second in command. He was made lieutenant-general in 1811, and appointed governor-in-chief of British North America, a position he held throughout the war that followed. In the War of 1812 he rendered important service to his government, but his defeat at Plattsburg in 1814 forced him to abandon his attempt to invade New York and brought him under censure. He died before a verdict of the court-martial had been rendered.

PRÉVOST D'EXILES, prā-vō dĕg-zēl, **Antoine François,** French author: b. Hesdin (Artois), 1 April 1697; d. near Chantilly, 23 Nov. 1763. He was at first a Jesuit, then enlisted in the army, after a brief return to the order again turned soldier, and still later joined the Benedictines of Saint Maur. Subsequently he lived in Holland and England, and in 1735 became almoner and secretary of the Prince de Conti. He was a great admirer of England and things English and his writings, his influence and his translations from English into French created a great interest in English literature; and this in its turn helped to pave the way for the democratic and liberal tendencies which later took possession of the literature of France. Rousseau was the first great writer notably to exhibit this tendency. ‘Manon Lescaut,’ which became immensely popular, influenced most of the great writers from the days of Prévost to Victor Hugo. He founded *Le Pour et le Contre,* a journal patterned after the *Spectator,* which ran through 20 volumes (1733–40); translated Richardson and Hume's ‘History of England’; and wrote a ‘Histoire des Voyages’ (1747–80), and several works of fiction, including ‘Le Doyen de Killérine’ (1732–35); ‘Mémoires et Aventure d'un Homme de Qualité qui s'est Retiré du Monde’ (1728–56), which includes ‘Manon Lescaut,’ a story of some celebrity in French literature, frequently reprinted, and the basis of a drama (1851) by Barrière and Fournier and ‘Contes, Aventures et Faits Singuliers’ (1764). A selection from his works appeared at Paris in 1810–16. (See MANON LESCAUT). Consult Harisse, ‘L'Abbé Prévost’ (Paris 1896); Schroeder, V., ‘Un romancier français XVIIe siècle, l'abbé Prévost’ (Paris 1898); ‘Rousseau and the Cosmopolitan Spirit in Literature’ (New York 1899); ‘Sainte-Beuve,’ ‘Causeries de lundi’ (Vol. IX, Paris 1862).

PRÉVOST-PARADOL, prā-vō pä-rä-dŏl, **Lucien Anatole,** French writer: b. Paris, France, 8 Aug. 1829; d. Washington, D. C., 11 Aug. 1870. He was educated at the Collège Bourbon and the École Normal, was editor of ‘La Revue d'Histoire Universelle’ in 1854 and in 1855 accepted the chair of literature at the University of Aix, but resigned in 1856 to become editor of the Paris *Journal des Débats.* As a journalist, his keen irony, his brilliant, forcible style rendered him a formidable adversary. A believer in constitutional government he was opposed to Napoleon III. His articles were instrumental in recalling the French army from Mexico, but his contributions to the *Courier du Dimanche* caused the suppression of that journal in 1866. After the formation of the Ollivier ministry in 1870 he became reconciled to the empire and accepted the post of Ambassador to the United States. The trying conditions of the war had generally preyed upon his mind and he committed suicide shortly after his arrival. His editorials are still considerable models of journalistic style and his books include ‘Du Rôle de la Famille dans l'Education’ (1857); ‘Quelques Pages d'Histoire Contemporaine’ (4 vols., 1862–66); ‘La France Nouvelle’ (1868). Consult Gérard, ‘Prévost-Paradol’ (Paris 1894).

PREWITT, proo'ĭt, **Theodore Frelinghuysen,** American surgeon: b. Fayette, Mo., 1 March 1832; d. Saint Louis, Mo., 17 Oct. 1904. He was graduated at the Saint Louis Medical College in 1856 and engaged in practice at Utica, Mo., but in 1863 removed to Saint Louis where he remained. He was resident physician and surgeon at the City Hospital, chief surgeon of Saint John's Hospital and dean of the Missouri Medical College. After the consolidation of the Missouri Medical College with the Saint Louis Medical College as the medical department of Washington University he occupied the chair of surgery. He was president of the Saint Louis Medical Society, the Missouri State Medical Society and of the American Surgical Association.

PREYER, prī'ĕr, **Wilhelm Thierry,** German physiologist: b. Manchester, England, 4 July 1841; d. Wiesbaden, Germany, 15 July 1897. He was educated in the universities of Bonn, Berlin, Heidelberg, Vienna and Paris, took degrees in both philosophy and medicine and in 1869 was appointed professor of physiology at Jena. In 1888 he became privat-docent at Berlin. He has made valuable investigations in the fields of quantitative spectral analysis, the perception of sound and the precise qualities of the senses. He carried on important researches relative to the blood, respiration and similar subjects. Of his books the most famous is ‘Die Seele des Kindes’ (1881), and especially deserving of mention are ‘Ueber Empfindungen’ (1867); ‘Ueber die Grenzen der Tonwahrnehmung’ (1876); ‘Elemente der allgemeinen Physiologie’ (1883); ‘Der Hypnotismus’ (1890).

PRIAM, prī'ạm, the last king of ancient Troy, was the son of Laomedon and Strymo or Placia. He was the 6th of the Trojan kings and reigned 40 years. His territory included Lesbos, Mysia and the Hellespont. When a youth he marched with the Phrygians against the Amazons, and went as ambassador to the Thracians. After the death of his father he reigned in Troy. By his first wife, Arisbe, daughter of Merops, he had Æsacus. He afterward gave Arisbe to Hyrtacus, and married Hecuba, by whom he had, according to Homer, 19 children, among whom Hector, Alexander or Paris, Creusa, Laodice, Polyxena, Cassandra, Deiphobus, Helenus, Pammon, Polites, Antiphus, Hipponous, Polydorus and Troilus were the most distinguished. By four concubines he also had 30 sons and four daughters. When he was extremely old the Greeks demanded of him the restoration of Helen, who had been carried away by Paris, and on his refusal to give her up they made war against Troy, took and destroyed the city, after a siege of 10 years, his son Hector having already fallen. According to later legends, when the Greeks entered the city he armed himself, to seek death in the midst of the enemy; but Hecuba prevailed upon him to take shelter at the altar of Zeus. Here he saw his son Polites fall by the hand of Pyrrhus; and, unable to contain himself, hurled his javelin at the youth, who dragged the old man by the hair from the altar and plunged a sword into his breast. See TROY.

PRIAPUS, prī-ā'pŭs, in Greek mythology, a field and garden god especially honored in Lampsacus, a town of Mysia, situated in a rich wine country. Aphrodite bore him to Dionysus when the latter was returning from India, though his father unwillingly acknowledged him on account of his ugliness. The first fruits of the crops were offered to him as the god of the fields, the protector of gardens, bees, goats and sheep. Homer and Hesiod do not mention him and it was only in later times that he was honored with divine worship. He was represented with horns and goat's ears, and large phallus, having in his lap all kinds of fruit; in his hand he held a sickle, and usually a horn of plenty. His worship spread from Lampsacus to Greece and thence to Rome. He represents the productive power of nature and is the god of sensual pleasure. His image was set up in gardens and fields to scare away birds; and this was probably the origin of the modern scarecrow; at any rate the «scare-crow» idea had begun to take possession of the more educated before his worship disappeared; and his name was made the subject of many coarse jests by the poets and writers.

PRIBER, prē-bär, **Christian,** French Jesuit in America. He came among the Cherokee Indians in 1736 and took up his residence with them in Great Tellico Town in what is now East Tennessee. Intending to make a dictionary and grammar of the Cherokee language he adopted the dress of the Indians to lessen their feeling of his being a stranger, meanwhile striving to civilize and convert them. His influence among the Cherokees grew to such an extent that they adopted a code of laws he prepared for them thereby exciting the distrust of the English government of South Carolina. Fearing French influence the English demanded Priber from the Indians, who refused to surrender him, and the safety of the English envoy was secured only by Priber's interference. But while traveling in Alabama in 1741 he was seized by the English authorities and cast into prison in Frederica, Ga., where he soon died.

PRIBILOF, prē'bē-lôf, or **«FUR SEAL ISLANDS,»** a group of islands in Bering Sea, belonging to the United States, about 200 miles north of the Aleutian Islands and 320 miles west of Bristol Bay. The largest islands of the group are Saint George, Saint Paul, Walrus and Otter, while the others consist of a number of islets, all of volcanic origin. The total area is about 180 square miles. This group is of great importance as here is the breeding place of the fur-seal, sea-bear, otter and blue-fox. About May the seal come to Pribilof Islands, where the fog hangs over the land almost continuously. The islands were discovered toward the end of the 18th century by Gerassim Pribylof (or Pribyloff), a Russian, and first mate on the boat *Saint George*. He had been drifting about in the Bering Sea, looking for the breeding place of the fur-bearing seal, and at last he found it. He took possession of the island for Russia, and named it Saint George after his boat. Later the second island was discovered and called Saint Paul and the whole group was named after its discoverer. There are on the islands about 600 permanent residents. Saint Paul, the largest island of the group, has an area of about 35 square miles and a population of over 200. Saint George has about half this population and an area of 27 square miles. In 1868 the Pribilof Islands were made a fur-seal reservation by the American government; and since then schools and churches have been built on the islands, reindeer have been introduced and the condition of the natives has been very materially improved. Consult Elliott, H. W., ‹Our Arctic Province› (New York 1887); Greely, A. W., ‹Handbook of Alaska› (New York 1914); Jones, E. L., ‹Report of Alaska Investigations in 1914› (Washington 1915).

PRICE, Bonamy, English economist: b. Saint Peter Port, Guernsey, 22 May 1807; d. London, 8 Jan. 1888. He was educated at Worcester College, Oxford, and in 1830–50 he was assistant master at Rugby. He then engaged in business and literary work in London and from 1868 he was Drummond professor of political economy at Oxford. He was popular as a lecturer on political economy and was an advocate of free trade. He lectured in the United States in 1874. Besides numerous pamphlets he was author of ‹Principles of Currency› (1869); ‹Currency and Banking› (1876); ‹Chapters on Practical Political Economy› (1878).

PRICE, Ira Maurice, American Orientalist: b. Welsh Hills, near Newark, Ohio, 29 April 1856. He was educated at Denison University, the Baptist Union Theological Seminary at Morgan Park, Ill., and at the University of Leipzig. He was professor of Greek and modern languages at the University of Des Moines (now Des Moines College) in 1879–80; and subsequently was connected with the faculties of the Morgan Park Military Academy, the Wheaton (Ill.) Theological Seminary and Harper's Hebrew Correspondence Schools. He was instructor and later professor of Hebrew and cognate languages at the Baptist Theological Seminary in 1886–1900. In 1900 he became professor of Semitic languages and literature at the University of Chicago, and since 1910 he has also been secretary of that department. He has been associate editor of the *Biblical World* and of the *American Journal of Semitic Languages and Literature* since 1892, and of the *American Journal of Theology* since 1867. He was a contributor to Hastings' ‹Dictionary of the Bible› and ‹Dictionary of Religion›; ‹The Jewish Encyclopedia›; ‹Standard Bible Dictionary›; and the ‹Encyclopedia Americana›; author of ‹Introduction to the Inscriptions Discovered by M. De Sarzec› (1887); ‹A Syllabus of Old Testament History› (1890; 9th ed., 1915); ‹The Ancestry of Our English Bible› (1907; 5th ed., 1911).

PRICE, Julius Mendes, English traveler: b. London, England. He was educated in Brussels and at the École des Beaux Arts, Paris; entered journalism and was a special artist-correspondent of the *Illustrated London News*. In 1884–85 he served in the army with the Bechuanaland campaign in South Africa when he enlisted, for journalistic purposes, as a trooper, in Methuen's Horse, serving with the regiment until its disbandment. He went with the expedition to open up the Nordenskiold route to the interior of Siberia via the Kara Sea, the Arctic Coast of Siberia and up the Yenesei River. He became so interested in the country that he afterward traveled alone through Siberia, Mongolia, and the Gobi Desert via northern China, to Peking (1890–91). Four years later he visited the western Australian goldfields. He was with the Greek army in the Græco-Turkish War in 1897, was engaged in an expedition in the Northwest Territory, Canada, and down the Yukon River to the

Klondike in 1898 and was in China in 1900–01. He served as special artist for the *Illustrated London News* and war correspondent of the *Daily Telegraph* during the Russo-Japanese War (1904–05). In the European War he was with the French army at first and later with the Italian Headquarters Staff, where he was official war correspondent to the Italian government in 1917. He has published ‘From the Arctic Ocean to the Yellow Sea’ (1892); ‘The Land of Gold’ (1896); ‘From Euston to Klondike’ (1898); ‘Dame Fashion’ (1913); ‘My Bohemian Days in Paris’ (1913); ‘My Bohemian Days in London’ (1914); ‘Six Months on the Italian Front’ (1917). He has also written many magazine and newspaper articles illustrated with his own sketches and drawings.

PRICE, Langford Lovell, English political economist: b. England, 20 July 1862. He was educated at Trinity College, Oxford; was lecturer to the Toynbee Trust in 1886–87 and in 1895–96; Nuomarch lecturer in statistics at University College, London; governor of Dulwich College, 1897; examiner at Victoria University in 1898 and in 1903 was called to that position at the University of Wales. He has published ‘Industrial Peace’ (1887); ‘West Barbary’ (1891); ‘A Short History of Political Economy in England’ (1891); ‘Money and its Relation to Prices’ (1896); ‘A Short History of English Commerce and Industry’ (1900); ‘The Study of Economic History’ (1908): ‘Co-operation and Copartnership’ (1914): ‘Ely and Wicker's Elementary Principles of Economics’ (1915).

PRICE, Richard, British Unitarian clergyman and political economist and moral philosopher: b. Tynton, Glamorganshire, Wales, 22 Feb. 1723; d. London, 19 April 1791. In 1743 he became pastor of a Unitarian congregation at Stake Newington, where he continued most of his life. He published in 1758 ‘Review of the Principal Difficulties in Morals,’ which was followed by ‘Four Dissertations on the Importance of Christianity, the Nature of Historical Evidence and Miracles, etc.’ (1767). In 1771 appeared his ‘Observations on Reversionary Payments and Annuities,’ succeeded by the celebrated ‘Northampton Mortality Tables,’ and other valuable works relating to life assurance and annuities. He also published ‘Appeal to the Public on the Subject of the National Debt’; and during the contest with the North American colonies, ‘Observations on the Nature of Civil Liberty’ and the ‘Justice and the Policy of the War with America’ (1776). This work was widely circulated in this country, and Congress, through Franklin, expressed its desire to receive his assistance in regulating the national finances. When Pitt became Prime Minister he consulted Price in his schemes for the reduction of the national debt, and the establishment of the sinking fund was by his recommendation. Consult Morgan, William, ‘Memoirs of the Life of Richard Price’ (London 1815).

PRICE, Sterling G., American soldier: b. Prince Edward County, Va., 11 Sept. 1809; d. Saint Louis, Mo., 29 Sept. 1869. He was educated at Hampden-Sidney College, studied law, removed to Chariton County, Mo., in 1831, and in 1840 was elected to the Missouri house of representatives, of which he was speaker until 1844 when he was elected to Congress. He resigned on the outbreak of the Mexican War and organized a cavalry regiment of which he was commissioned colonel. Under General Kearney he marched with his men from Fort Leavenworth to Santa Fé where he was left in charge. Attacked by the Mexicans he repulsed them severely and completed the conquest of California. In 1847 he was promoted brigadier-general of volunteers, became military governor of Chihuahua, and in 1848 won a decisive victory over the Mexicans at Santa Cruz de Rosales. In 1853–57 he was governor of Missouri, and in 1861 presided over the convention called to decide the secession question. He was a «Conditional Union» man but later joined the Confederacy, and in 1861 was appointed major-general of State forces, participating under Gen. Ben McCulloch, in the defeat of the Union forces at Wilson's Creek in August of that year. He then captured Lexington on the Missouri, but was forced to retreat before Frémont. He served under Van Dorn at Pea Ridge in 1862 and was promoted major-general in the Confederate army. He commanded one wing of Van Dorn's army at Corinth. He was defeated by Rosecrans at Iuka, Miss.; accompanied Beauregard in his retreat to Tupelo, and afterward serving in the Trans-Mississippi department, was there engaged in the unsuccessful attempt to capture Helena in 1863. In 1864 he succeeded in preventing General Steele's advance toward Red River, and later made a raid into Missouri. He was driven into southwestern Arkansas toward the close of the war and after the surrender he became interested in a colonization scheme in Mexico. Consult Snead, T. L., ‘The Fight for Missouri’ (New York 1886).

PRICE, Thomas Randolph, American educator: b. Richmond, Va., 18 March 1839; d. New York, 7 May 1903. He was graduated from the University of Virginia in 1855, studied at the University of Virginia and at Berlin and Kiel. In 1861 returned home to enlist in the Confederate army in which he served through the war on the staff of General Stuart. In 1867 he became professor of Latin and Greek at Randolph-Macon College, being later transferred to the Greek and English chair; and in 1876 he was appointed to the chair of Greek and Hebrew in the University of Virginia. In 1882 he was called to Columbia University as professor of English language and literature and remained at the head of the department until his death. He published ‘The Teaching of the Mother-Tongue’ (1877); ‘Shakespeare's Verse Construction’ (1889); edited ‘Othello’ in the Bankside Shakespeare (1890).

PRICEITE, a friable chalky mineral $3CaO.4B_2O_3.6H_2O$. A source of borax in Oregon.

PRICES. Price is value expressed in money. Thus, price is not identical with value. It is an expression of value in terms of some one commodity, which commodity is called money. Value is thus the more fundamental term; it is the thing expressed, whereas price is the expression of the thing.

The general scale of prices may rise or fall without any material change in the supply of or the demand for commodities in general. The forces of supply and demand, however, operate upon money as well as upon other commodities. It is quite possible for money to become cheap, in which case considerable quantities of money will be given in exchange for small quantities of other commodities. This makes what we call «high prices.» On the other hand, money may become dear, in which case small quantities of money are given in exchange for large quantities of the other commodities. This is what we call «low prices.» The causes of high or low prices therefore may operate on money alone or they may operate on the other commodities for which money is exchanged.

It is commonly assumed that money is cheap or dear according as it is abundant or scarce. The abundance or scarcity of money is undoubtedly a factor in determining its cheapness or dearness; but with money, as with all other commodities, demand is as important as supply. The supply or the quantity, therefore, is only one factor in the problem. With an abundance of money, if there is a general desire to hold on to it and a reluctance to spend it or to let it go, it may remain dear and its purchasing power may remain high. That is, when every one who lacks money is anxious to get it, and every one who has it is reluctant to part with it, large quantities of other commodities may be offered in exchange for small quantities of money. On the other hand, when there is no great eagerness to acquire money except as a means of purchase, no general disposition to hold on to it or reluctance to part with it, it is likely to be cheap; and when every one who lacks money desires to possess it solely for the purpose of spending it quickly, and every one who has it is anxious to spend it for the purpose of getting other commodities as quickly as possible, the result is cheap money or high prices. Large quantities of money are freely spent in order to get small quantities of the other commodities.

If we assume, even for a short period of time, that no change has taken place in the quantity of money or in the desire to possess it, then such change of prices as occurs will be due to factors affecting other commodities. Any change of fashion with respect to dress goods, or change of habit with respect to food, will of course bring about a considerable readjustment of prices. Under such conditions, these changes in the price list become a fairly accurate expression of the desires of the people. That which is most desired will command the highest price. That which is least desired will command the lowest price, whether it be in material commodities or the services of labor which are under consideration. The price list is therefore a pretty safe guide to the desires or wants of the community, and he who is anxious to give the community what it desires could scarcely do better than to follow the price list, whether he be producing commodities or selling his labor. Consult Laughlin, J. L., 'Money and Prices' (New York 1919).

THOMAS N. CARVER.

PRICHARD, James Cowles, English ethnologist and physician: b. Ross, Herefordshire, 11 Feb. 1786; d. London, 22 Dec. 1848. He studied medicine at Bristol, London and Edinburgh, began practice at Bristol in 1810, and in 1814 became physician to the Bristol infirmary. In 1813 he published 'Researches into the Physical History of Mankind' (extended to five vols., 1836-47); 'The Eastern Origin of the Celtic Nations' (1831); 'Natural History of Man' (1843); 'Insanity and Other Disorders Affecting the Mind' (1835); 'Different Forms of Insanity in relation to Jurisprudence' (1842); 'The Relation of Ethnology to other Branches of Knowledge' (1847). In 1845 he was appointed one of the London commissioners of lunacy.

PRICKLY ASH, any of several prickly shrubs of the United States of the rue family (*Rutaceæ*) and genus *Xanthoxylum*, especially *X. clavaherculis*, whose aromatic and pungent bark is used in the Southern States as a rustic remedy for toothache. In the south this bush is therefore known as toothache-tree and pepper-wood.

PRICKLY HEAT. See MILIARIA.

PRICKLY PEAR, a genus (*Opuntia*) of American cactus. About 130 species have been recognized in the region they occupy from British Columbia through the western States, Central America and West Indies to southern South America. They are very variable in their specific characters, and the lines between species are very indistinctly marked. Some are very dwarf prostrate plants; others are tree-like in height and spread of top. They have club-shaped, cylindrical or flat spiny or hairy, fleshy stems, and except upon the youngest joints bear no leaves. These leaves drop off very soon. The flowers, which are borne near the upper parts of the joints or stems and on the most bristly parts, are solitary or in corymb-like panicles and are usually yellow and very showy. The fruit is a modified stem, the ovary being sunken in its apex. It varies with different species from dry to fleshy and succulent, in many species being edible. Prickly pears were in cultivation among the natives when America was discovered, and were introduced by the Spaniards to the Mediterranean region, and finally to Asia, South Africa, Australia, etc. In all these places they are now regarded as troublesome weeds, though in many they are valued for their fruit. In Sicily they are one of the chief crops, the peasants living mainly upon the fruit from July to November. Since some of the varieties will produce about nine tons of fruit to the acre upon land too rocky, thin or poor for other crops; since this production can be counted upon for a long series of years without any cultivation after the plants become established (in three years or less, usually); and since they are highly nutritious, their value is not over-estimated in climates adapted to their culture; namely, dry and frostless. They contain about 14 per cent of sugar and nearly 2 per cent of fat. A crop of nine tons per acre would, therefore, be equivalent to about 2,500 pounds of sugar.

In view of these statements it seems strange that attention has not been directed to improvement of varieties, etc. They have not been ranked with horticultural fruits, though they are of far more economic importance than many that are. In many sections they are used for stock feeding, especially in seasons of drought. The spines are generally rubbed or burned off, but cattle often eat them without this treatment, and frequently suffer death because the spines pierce their intestines. Of late, however, spineless varieties have been cultivated successfully and are used chiefly for stock feed. The plants are most used for fodder in the western States, Africa and Australia. In Tunis, dairymen are rarely without a plantation of prickly pear for their herd. The plants are also planted for ornamental purposes in gardens and greenhouses in many parts of the world not adapted to their cultivation; and in places adapted to them they are favorite hedge plants. The most esteemed species are probably the Indian fig (*O. ficus-indica*), the tuna (*O. tuna*), *O. engelmanni*, and *O. fulgida*, the first two being especially valued for the fruit, the last two for their fodder. *O. vulgaris* is a common species in the eastern States and is hardy as far north as Massachusetts.

PRIDE, Thomas, English Parliamentary officer: d. Nonsuch, 23 Oct. 1658. Early in life he was a brewer and began service in the Civil War as ensign under the Earl of Essex; he was finally promoted colonel. As a soldier he won considerable distinction, being conspicuous at Preston (17–19 Aug. 1648), and commanding a brigade in the Scottish campaign. An extreme anti-Royalist, he was selected by the army to exclude the Royalist members from the House of Commons. (See PRIDE'S PURGE). He was one of the judges of Charles I, whose death-warrant he signed. During the lord-protectorship of Cromwell, he was knighted and made a member of the newly organized House of Lords. See FAIRFAX, CROMWELL, and CHARLES I.

PRIDE OF INDIA, PRIDE OF CHINA, a tree (*Melia azedarach*), of the mahogany family, a native of Lebanon, Syria, Persia and the north of India, and cultivated in different parts of the world as an ornamental tree. It is known in different localities as CAPE LILAC; PERSIAN LILAC; CHINA TREE; PARADISE OR PARAISO TREE; and in Southern America frequently, but incorrectly as PEPPER TREE; and in Australia as WHITE CEDAR. It grows to the height of 30 or 40 feet with a trunk of 20 inches diameter; but in open spaces it is spreading and not so high. Its leaves consist of smooth, pointed, dark green leaflets, arranged in pairs with an odd one at the end. The flowers, hanging in clusters at the ends of the branches, are of lilac color and agreeable perfume. They give place to bunches of berries about as large as cherries, and yellow when ripe. The fruit is sweetish, and edible, though generally supposed to be poisonous. In the cities of the Southern States where the tree was introduced by the elder Michaux early in the 19th century, and upon many of the plantations, rows of Pride of India trees are very common, and in autumn the branches and the ground beneath are covered with their berries. One of its most attractive forms is known as the TEXAS UMBRELLA TREE. A decoction of the bark of the root is administered as a cathartic and vermifuge. In large doses it is said to produce narcotic effects, and such appears to be the action of the ripe berries upon the robin redbreasts, which are very fond of them, and eat them until they become stupefied and fall to the ground. From this state, however, they soon recover.

PRIDE AND PREJUDICE. An admirer of Jane Austen's novels is certain to regard as the best the one he happens to be reading, so admirable are they all in those qualities which make for perfect work; but on reflection he will probably give the palm to 'Pride and Prejudice,' if for no other reason, because he remembers it the longest. This novel, with its clean-cut, logical plot, was published in 1813, though its first draft dates as far back as 1796–97, when Jane Austen was in her 22d year. It is the novel of a girl — a clergyman's daughter — who had been bred in the country among the minor gentry. The scene, except for a few excursions, is laid in two English villages named Longbourn and Meryton. Within these narrow limits, Jane Austen studies the Bennet family — consisting of Mr. and Mrs. Bennet and their six daughters — in relation with their neighbors, and especially with the tenant of Netherfield Park, the young Mr. Bingley and his friend Mr. Darcy. In the end Jane, the eldest daughter of the Bennets, is married to Mr. Bingley; and Elizabeth, the second daughter, to Mr. Darcy; while a younger sister, Lydia, elopes with Mr. Wickham, the villain of the story, who holds a commission in the militia stationed at Meryton.

The novel takes its title from the two leading characters — Mr. Darcy, who is proud of his birth, fortune and attainments, and Elizabeth Bennet, who resents his apparent condescension and superciliousness, and, not understanding his true character, becomes inordinately and unjustly prejudiced against him. Elizabeth's prejudice is first awakened at a village ball, where she overhears a remark of Darcy's in disparagement of herself and the other girls; it is strengthened by Darcy's attempt to detach Bingley from Jane, and by a false story about his dishonorable treatment of Wickham. All the time Darcy is falling in love with Elizabeth, attracted by her very fine eyes, her vivacity, her frankness, her keen intelligence and genuine charm. The climax is reached when Darcy proposes and Elizabeth spurns him. Thereupon Elizabeth soon learns why Darcy has cast off Wickham, the spendthrift and libertine; she is made to understand why he has interfered in the match between Jane and Bingley; and she discovers that but for Darcy, who patched up a marriage between Lydia and Wickham, lasting disgrace would have fallen upon the entire Bennet household. Elizabeth and Darcy come to understand each other perfectly. Pride and prejudice vanish: and the conclusion is as logical as a mathematical demonstration.

In tone and atmosphere, 'Pride and Prejudice' is the novel that approaches nearest to Shakespeare's 'Much Ado About Nothing' (q.v.) Elizabeth and Darcy give us much the same delight that we feel when we read of the wit combats between Beatrice and Benedict. All the other characters are also carefully differentiated. The novel is pervaded with pure comedy, which Jane Austen occasionally allows to approach farce in the delineation of Mrs. Bennet, the match-making mother, and in the Rev. Mr. Collins, who would marry Elizabeth in order to promote his own happiness at the expense of hers. There is no tragedy in the novel. Over all the domestic affairs of life Jane

Austen lets her mind play, diverting the reader with "follies and nonsense, whims and inconsistencies." Scott despaired of ever attaining to her delicate protrayal of character; and her art has had a potent influence upon Trollope and other later novelists down to Mr. Howells, who writes of her as "the divine Jane."

WILBUR L. CROSS.

PRIDEAUX, prid'ō, **Humphrey**, English scholar and divine; b. Padstow, Cornwall, 2 May 1648; d. Norwich, 1 Nov. 1724. He was graduated from Christ Church, Oxford, in 1672 and was appointed rector of Saint Clement's, Oxford, in 1679, prebend at Norwich in 1681, archdeacon of Suffolk in 1688, and in 1702 became dean of Norwich. He was a man of studious habits, a deep thinker, acquired a vast store of knowledge, and a wide reputation for judgment, integrity and wisdom. His greatest work was entitled 'The Connecticut of the History of the Old and New Testaments' (4 vols., 1715–18). Among his other works are 'Marmora Oxoniensia' (1676); 'Life of Mahomet' (1697). Consult Thompson, E. M., for his letters to John Ellis, Under-Secretary of State, (published by the Camden Society in 1875); the 'Bibliotheca Cornubiensis' (Vols. II and III); and a 'Life of Humphrey Prideaux' (published anonymously in 1748).

PRIDEAUX, John, English soldier: b. Devonshire, 1718; d. near Fort Niagara, N. Y., 19 July 1759. He entered the army in early youth, and attained the rank of brigadier-general in 1759. In that year he was given command of one of the four divisions which were sent to conquer Canada, and while Amherst, Wolfe and Stanwix co-operated in the north, Prideaux attempted the reduction of Fort Niagara, one of the strongest fortresses in possession of the French. He landed before the fort on 7 July and opened an attack, repelled a sortie on 11 July and on the 19th prevented the landing of the French reinforcements sent by Frontenac, but was killed in the trenches on the same day by the premature bursting of a shell. His work was not without results, however, as the fort surrendered on the 24th. Consult Parkman, Francis, 'Montcalm and Wolfe' (Boston 1884).

PRIDE'S PURGE, the familiar name for the forcible exclusion of Royalist members from the House of Commons in 1648 by Col. Thomas Pride. See PRIDE, THOMAS.

PRIENE, pri-ē'nē, in ancient history, a city of Ionia at the mouth of the Gæson in early times, but because of the alluvial deposits of the Mæander finally lay several miles from the coast. One of the 12 cities in the Ionian League, Priene was conquered by Ardys, a Lydian king, in the latter part of the 7th century B.C. It was mixed up in several revolts against the Persian power, notably the Ionic trouble (500–494 B.C.). Shortly after Priene fell into the hands of Athens. During the power of Alexander in Asia Priene flourished. A new city was laid out and it and the old beautified by additions of the best art of the day. Sometime during the reign of the Byzantine rulers, the city was deserted and it was subsequently covered by débris caused principally by earthquakes, and on Crœsus' overthrow became the property of Persia. The great temple of Athena Polias, the scene of the festival called the Paniona, was here; a dedication upon it by Alexander the Great is now in the British Museum. In 1868 the temple of Athena Polias (erected under the direction of Pythias) was excavated for the Dilettanti Society by Pullan and Newton, who have shown that it was one of the finest pieces of Ionian architecture ever built. The plan of the ancient city has been made plain by explorations in 1895–99 under the management of the Royal Museum in Berlin. These show that the city had been planned with great care and had been looked after as the best of the Greek cities were. The excavations, therefore, have made of the ruins one of the most important sources of information concerning the Greek city life of the period. The market place, theatre, temples and other public buildings, together with a vast amount of sculpture and inscriptions, were unearthed. Consult Bædeker, 'Konstantinopel, Balkanstaaten, Kleinasien' (Leipzig 1914); Frothingham, A. L., 'Priene' (*Century Magazine*, Vol. LXII, 1901); Gärtringen, H. von, 'Inschriften von Priene' (Berlin 1907); Lenschau, 'De Rebus Prienensibus' (Leipzig 1890); Leutner, 'Priene' (*Classical Weekly*, Vol. V, 1911); Pullan and Newton, 'Antiquities of Ionia' (London 1881); Wiegand, 'Priene' (Berlin 1898).

PRIESSNITZ, prēs'nĭts, **Vincenz**, founder of the Kaltwasskur, or system of hydropathy (q.v.): b. Gräfenberg, Austrian Silesia, 4 Oct. 1799; d. there, 28 Nov. 1851. Having effected by the application of cold water a cure of a severe injury he had received, he subsequently employed it in local cases as a healing agent. Two English physicians, Sir John Floyer and Dr. Currie of Liverpool, had anticipated him in advocacy of the method, and a Silesian, Hahn, had published a book on it derived largely from a work by Floyer. But Priessnitz was the first to develop hydropathic practice. He established with the permission of the government an institution at Gräfenberg which was much frequented, among the guests being many physicians who came to study his claims. He wrote nothing himself, but many records of experiences of his cure, most of them favorable and many enthusiastic, were written by others. Consult the study by Selinger (1852); and Philo von Walde, 'Priessnitz als Begründer des Wasser- und Naturheilfahrens' (1897).

PRIEST, Josiah, American author: b. New York, about 1790; d. western New York, about 1850. He was a harness-maker, but became self-educated and published several books, some of which became very popular. Among them were 'Wonders of Nature' (1826); 'View of the Millennium' (1828); 'Stories of the Revolution' (1836); 'American Antiquities' (1838); and 'Slavery in the Light of History and Scripture' (1843).

PRIEST, one who performs the sacred rites of any religion, especially the sacrificial rites, and who is thus a mediator between the Deity and men.

In primitive times the function of priesthood was inherent in the head of a family, the *pater familias*; but as states were organized priesthood on behalf of the people was assumed by the chief or king, or was exercised, under him, by a special order of men; but still the rites of domestic religion would continue to be performed by the head of the household. In early Greece and Rome when kings were banished and the power of the state came into the hands of elected magistrates the priestly office of the king, or his headship in religious affairs, was vested in the *archon basileus* as at Athens, or the *rex sacrorum* as at Rome; the term king (*basileus, rex*) being retained after kingship had been done away, doubtless because of some religious scruple, lest the gods should resent the lowering of the appellation of the head of the state religion. The priests of the state religion were now appointed by the public authority, whether their functions were general or were restricted to the service of special gods in special temples.

In Rome there never was in pagan times anything like a priestly order or priestly caste or class, as the order of knights (*equites*) or patricians (*patricii nobiles*), nor was priesthood hereditary. In Greek states the priestly service in certain temples and places was restricted to certain families; for the rest the priesthood was a function of the state. In Egypt the priesthood was a very close corporation, the members of which, with the king at their head, were the supreme arbiters of civil and even military as well as of religious affairs; the priesthood alone possessed whatever science existed of the mysteries of religion or of the secrets of statecraft, or the laws of nature.

In primitive Israel, as in other primitive societies, priesthood was the attribute of the father of the family: the priest by vocation, as a man set apart to minister on behalf of the people in their relations to the Deity, does not come into view till the Mosaic epoch; and the fully developed priestly system of Israel did not come into existence till the time of Solomon or even, perhaps, till after the return of the people from Babylon and the building of the second temple at Jerusalem by Zerubbabel in 520 B.C., nearly 500 years after Solomon's reign. Before the building of Solomon's Temple there were in Israel several temples or sanctuaries with oracles that were consulted to ascertain the will and pleasure of Jehovah, and with priests as their interpreters; and the priests and the Levites constituted a distinct order of society; but after the secession of northern Israel every devout king of Judah earnestly sought to suppress religious worship or sacrifice everywhere save in the central national temple: this end was not achieved till after the return of the captives from Babylon. Henceforth the worship even of the true God elsewhere than in the temple at Jerusalem was denounced as impious and little different from worship of false gods. The entire priestly order was massed in Jerusalem and its neighborhood; the priests were distributed into 24 classes, each presided over by a chief priest, and each class of priests ministering in the temple one week in rotation. Over the whole priesthood presided the high priest, believed to be always a lineal descendant of Aaron, the brother of Moses.

The ministers of the several religions mentioned, as well as those of Phœnicia, Babylon and other countries, are styled in English «priests»: in Hebrew, Greek and Latin, respectively, the priest is *Kohen, hiereus* and *sacerdos*. But the English word priest, derived from the Greek *presbyteros*, an elder person, has not in itself any denotation of sacrifice or of priestly function but only of maturity of age.

In the Greek New Testament the priest of the Jewish law is always called *hiereus* and in the Latin Vulgate version *sacerdos*, never *presbyteros*, or *senior* (elder). On the other hand, neither in the Greek original nor in the Vulgate Latin version of it is *hiereus* or *sacerdos* ever said of the minister of the religion of Jesus Christ, but always *presbyteros* and *presbyter*; and in the authorized English version *presbyteros* is invariably rendered elder, never priest. Nevertheless, in the Book of Common Prayer of the Anglican Church and in that Church's Articles of Religion the word priest is everywhere employed instead of elder; but this «priest» of the Prayer Book is not *hiereus, sacerdos*, a sacrificing priest; for in the Articles the sacrificial function of the priest of the Catholic Church is classed with «blasphemous fables and dangerous deceits.» Hence for the Anglican Church, as for all the other Protestant churches, the priest, presbyter or elder is not the minister of a sacrifice. It is different in the Catholic Church and in the numerous Christian churches of the East. Those churches teach, with the Church of Rome, that in the Christian dispensation it is the chief office of the priest to offer sacrifice, namely, the eucharistic oblation, which is a perpetual representation of the offering made on Calvary. In the belief of those churches the mass is the selfsame sacrifice which Christ offered — the victim the same, the priest the same: for the victim is Jesus Christ, his body and blood; and the priest is the incarnate Son of God in Heaven, the High Priest, who is represented in the mystic offering by the priest who ministers at the altar.

It is worthy of mention that till the middle of the 3d century no extant writing of any of the fathers employs the Greek or the Latin word for priest (*hiereus, sacerdos*) to designate the *presbyteros*. In the Roman pontifical the order of the priesthood is called both *presbyteratus* and *sacerdotium*.

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PRIEST OF KIRCHFELD, The. The folkplay in Viennese dialect, 'Der Pfarrer von Kirchfeld,' produced 5 Nov. 1870, in Vienna, is Anzengruber's most popular drama even if in the opinion of the critics it is not his best. It raised a struggling unknown author to fame, partly because of its freshness and inherent excellence, but more because it voiced popular feelings in regard to the celibacy of the clergy, mixed unions, enforced civil marriage and the relation of church and state as affected by the declaration of papal infallibility in 1870.

The scene is laid just outside of Austria in the most conservative portion of Old Bavaria among a simple peasantry "whose passions, expressed without reservation or but clumsily concealed" were a novel revelation of human nature to theatregoers. Priest Hell and his feudal adversary, Count Finsterberg, reveal by their very names the nature of the conflict which is precipitated by Hell's innocent gift of a little gold cross to his ward, the orphaned, penniless Annerl. This gives the vagabond Wurzelsepp an opportunity to ruin the Priest with his parish as an expression of hatred caused by ecclesiastical prevention of his union to a Lutheran girl 20 years before. In the best scene of the play Hell converts and wins the friendship of this enemy when he permits the burial of Wurzelsepp's suicide mother in consecrated ground. But this employment of his own judgment against the law of the Church loses for him his parish.

Though a member of the "church militant and regnant" he had sought like the 'Monk of Wittenberg' for a way short of the requirement to inquire "May I do it, just as I mean it?", a way which makes men "indifferent or apostate." Herein lies a part of the tragedy of his position. However, he becomes no champion of the "Away from Rome" movement, which later gained such strength. He conquers self, and submits. More tragic, almost to the point of suicide, is his love for Annerl, who also learns resignation like all Austrians, by giving hand and allegiance to the peasant, Michel. It is this soul conflict, more than its politico-religious purpose, which makes the play great. First produced in the Folktheatre "an der Wien," it gradually found its way over all German-speaking lands, being played 632 times between 1899 and 1905. Text Vol. VI of Gesammelte Werke (1898). Criticism Sigismund Friedmann, 'Ludwig Anzengruben' (Leipzig 1902).

Carl E. Eggert.

PRIESTLEY, prēst'lĭ, **Joseph,** English physicist and Unitarian divine: b. Fieldhead, Yorkshire, 13 March 1733; d. Northumberland, Pa., 6 Feb. 1804. After a secondary education he accepted an invitation to become Presbyterian minister of Needham Market, Suffolk, on an average salary of £30 a year. After three years he took charge of a congregation at Nantwich, Cheshire, to which he joined a school. Here his reputation increased, and in 1761 he was invited by the trustees of the Dissenting academy at Warrington to occupy the post of tutor of languages and *belles-lettres* under Dr. Aiken. A visit to London having introduced him to Drs. Franklin, Watson and Price, he was encouraged to compose a 'History of Electricity,' which appeared in 1767. In the same year he became minister, at a salary of £100 a year, of the Mill Hill chapel at Leeds, where his religious opinions grew decidedly Unitarian. At Leeds his attention was first drawn to the properties of "fixed air" (carbonic acid gas); and about this time he completed his 'History and Present State of Discoveries relating to Vision, Light and Colors.' In 1771 he agreed to accompany Captain Cook on his second voyage in the capacity of astronomer, but his appointment was canceled, as the Board of Longitude objected to his theology.

After six years at Leeds he accepted an invitation from the Earl of Shelburne, afterward Marquis of Lansdowne, to reside with him as a companion in the nominal capacity of librarian. While forming a part of the establishment of this nobleman, he occupied himself in scientific pursuits, and in 1773 gave to the 'Philosophical Transactions' a paper on the different kinds of air, which obtained the prize of Copley's gold medal. On 1 Aug. 1774 he discovered oxygen or "dephlogisticated air," as he called it, a result quickly followed by other important discoveries, such as nitrous gas, nitrous oxide gas, sulphurous oxide gas, fluoric acid gas, muriatic gas and ammoniacal gas, etc. By these exploits he may be said to have been almost the first to render chemistry a precise science. In 1775 he published 'Examination of the Doctrine of Common Sense, as held by Drs. Reid, Beattie, and Oswald,' and soon after the treatise of Hartley. He had already declared himself a believer in the doctrine of philosophical necessity, and in a dissertation annexed to his edition of Hartley expressed some doubts of the immateriality of the sentient principle in man. This doctrine he still more forcibly supported in his 'Disquisitions on Matter and Spirit' (1777). Probably because of his "materialistic" views, the connection with Shelburne was dissolved in 1780, Priestley retaining an annuity by original agreement. He next removed to Birmingham, where he became once more minister of a Non-Conformist congregation, and occupied himself on his 'History of the Corruptions of Christianity' (1782), and 'History of the Early Opinions concerning Jesus Christ' (1786). With Erasmus Darwin, Watt, Boulton, Wedgewood and other famous men he founded the now celebrated Lunar Society, which rendered Birmingham for the time of its existence almost the intellectual centre of England. His 'Familiar Letter to the Inhabitants of Birmingham' was written in support of the claims of Dissenters for a repeal of the test acts. The era of the French Revolution, whose principles Priestley vindicated, added to the usual animosity of theological dispute. The anniversary of the capture of the Bastile being celebrated at Birmingham, a mob assembled, and although Priestley was not present, burned his house, and nearly all his library, manuscripts and apparatus. The outrage was countenanced by too many exercising both lay and clerical influence, and the legal compensation which he obtained fell short of his real losses by about £2,000. On 1 Aug. 1874, Birmingham made some amends for the wrong done to her greatest citizen, by the erection of a marble statue of him in front of the town-hall. On quitting Birmingham (1791) he succeeded his friend Price as preacher in the Gravel Pit Chapel, Hackney, where he remained some time in the cultivation of his scientific pursuits, until finally goaded by party enmity to seek an asylum in the United States, which he reached in 1794, and took up his residence at Northumberland, Pa. In America he dedicated his whole time to his accustomed pursuits. Some discourses of his led to the formation in Philadelphia of a Unitarian congregation and he held private meetings in his own house. He was never naturalized; and, curiously enough, never learned to make change in United States coinage. Priestley was an ardent controversialist, chiefly in consequence of extreme simplicity and openness of character; but no man felt less animosity toward his opponents than he did, and many who entertained the strongest antipathy to his opinions were converted into friends by his gentleness and urbanity in personal intercourse. As a man of science he stands high in the field of invention and discovery, and to few has pneumatic chemistry been so much indebted. On his own admission his researches in his favorite science were superficial, and his great discoveries to a considerable extent accidental. But this should detract nothing from the honor due to the earnest pioneer. As a metaphysician his elucidation of Hartley's theory of association, his works upon philosophical necessity and upon materialism will always insure attention. As a theologian Priestley, who followed his convictions wherever they led him, passed through all changes, from Calvinism to a Unitarian system in some measure his own; but to the last remained a zealous opposer of infidelity. Of his theological and controversial productions, those most generally esteemed are his ‘Institutes of Natural and Revealed Religion’ (1772–74), and ‘Letters to a Philosophical Unbeliever’ (1780–82). He also wrote many works of practical divinity. There is an edition of his ‘Theological and Miscellaneous Works, with Memoirs and Correspondence’ (1817–32).

PRIESTS OF THE MISSION. See LAZARISTS.

PRIESTS OF SAINT JOHN THE EVANGELIST. See ORDERS, RELIGIOUS.

PRIGG CASE, The, in American history, a famous slave case tried in 1837. Edward Prigg caused a fugitive Maryland slave-woman to be returned to her mistress, in violation of a Pennsylvania statute forbidding the carrying of any negro out of the State in order to enslave him. The case was finally brought before the Supreme Court of the United States, where it was contended that the statute was unconstitutional since it conflicted with the National Fugitive Slave Act of 1793. The opinion was handed down that the national law must be carried out by national authorities alone.

PRIM, Juan, hoo-än' prĕm, COUNT DE REUSS, MARQUIS DE LOS CASTILLEJOS, Spanish general and statesman: b. Reuss, Catalonia, 6 Dec. 1814; d. Madrid, 30 Dec. 1870. Destined for the law, he entered the ranks of the volunteers in the cause of the infant Queen Isabella on the outbreak of the civil war, which in 1833 followed the death of Ferdinand VII. At its close in 1839, Prim threw himself into politics, and when Queen Maria Christina quitted Spain, worked in behalf of the Progresista party against Espartero, who, 8 May 1841, had assumed the regency. In May 1843 he led the insurrectionist forces against Espartero, and upon the downfall of the Espartero ministry was rewarded by the queen by being created successively brigadier-general, Count de Reuss, and in 1843 governor of Madrid. Suspected later of conspiracy against the government in 1844, he was sentenced to six years' imprisonment but was released after six months, and made governor of Porto Rico. Distinguishing himself in the war against Morocco at the battle of Los Castillejos, 1 Jan. 1860, he was given the title of Marquis de los Castillejos. He commanded the Spanish expedition, which acting jointly with the French and English landed in Mexico early in 1862 to enforce claims of indemnity against that country, but withdrew his troops almost immediately. Again accused of conspiracy, he was banished in 1864, but headed an uprising in January 1866 against the government and was compelled to flee to England in 1867. From there he gave support to a revolution started in Spain that summer and in September suddenly appeared in Cadiz and fought against the government in the military revolution headed by Topete and Serrano. Upon the defeat of the government Serrano appointed Prim Minister of War in his provisional government. He became head of the Cabinet and procured the election of Amadeo, Duke of Aosta, second son of the king of Italy, as king of Spain. He was shot by unknown assassins while driving through Madrid. Consult Jimenez, F., ‘Historia Militar y Politica de D. Juan Prim’ (1860); Leonardson, ‘Prim’ (1901).

PRIMARY, Direct. A direct primary is an election held by political parties at which candidates for nomination are chosen directly by the voters of those parties. Under this method, voters select their nominees directly, whereas under the delegate or convention system the voters send their delegates to a convention at which the party candidate is nominted (see CONVENTION, POLITICAL). The convention system was so indirect in its methods and so many times accompanied by sharp practices on the part of rings of professional politicians and office-holders that a more effective method of nominating candidates was sought in order that nominees should represent the will of the rank and file of the party who cannot make politics their business. Moreover, the argument was advanced that the mass of the party members would regain control of the government of the party and the electors would exhibit a greater interest in party nominations. This has proven to be the case, the vote at the primaries as a rule being larger than under the delegate system, while the party electorate expresses its will more directly and effectively, thus making the party rulers more amenable to the party will. Even though the bosses may prepare a nomination "slate" or list of candidates at a preliminary or pre-primary caucus, the rejection of these candidates or the elimination of the unfit is an easy task, since the primary practically amounts to a referendum on the caucus nominees. Hence, party leaders are directly responsible for the personal qualities and principles of the candidates presented, and would scarely run the risk of discredit and overthrow by having the party electorate repudiate their candidates. In Oregon and some other States each candidate is afforded an opportunity to give widespread publicity to his platform or principles; the pictures and statements of all the candidates are printed and bound in a publicity pamphlet, which, for a small consideration, is distributed to the voters before the primary. In Wisconsin a candidates' convention frames the platform, the convention consisting of all party candidates for State offices and for the legislature and of any members of the senate who have held over. Thus the voter receives a concrete statement of the policy by both the legislative and executive departments. In Missouri the State central committee, together with the party nominees for State office, for the legislature and for Congress, formulate the platform. In Oregon, when the petition is filed, the candidate may set forth his principles in a paragraph of not more than 100 words, and he is also allowed a 12-word sentence upon the ballot. If 10 per cent of the party voters in Texas petition, a question of party policy must be submitted to the voters at the primary and the party cannot be pledged to any policy which has not been endorsed by a majority of the voters.

In most States a mere plurality of votes cast determines the nomination, but in the Southern States a clear majority is often required and if no candidate should receive the necessary number of votes a second primary is held at which only the two leading candidates are considered. Some States use the minimum percentage plan, Iowa requiring 35 per cent of the total vote, while Michigan requires 40 per cent for governor and lieutenant-governor. Idaho, North Dakota, Wisconsin and a few other States have adopted a system known as preferential voting, under which first and second choices for a given office are indicated and if no candidate receives a majority of first choice, the lowest candidate is dropped and the second choices are then distributed. The object of the preferential vote is to eliminate a second ballot and to prevent the choice of a candidate by plurality only. In some cases even third choices may be indicated.

The advent of the direct primary has had a large influence on the personnel and character of the national government, since it affects the choice of senators, representatives, Presidential electors and delegates to national conventions. The application of direct primaries to senators and representatives has been provided for without extended discussion, but the States have been slow in applying the system to the choice of delegates to the national nominating conventions. Wisconsin started the movement and several other States have provided for a direct vote for delegates. The next move is to have the electors of each party in each State at the direct primary instruct their delegates to the national convention as to the party preference for Presidential nominee. A primary law extended to Presidential nominations was adopted by Oregon in 1910 and since that time the Presidential preference primary has been adopted by many States. (See PRIMARY, PRESIDENTIAL PREFERENCE). After all the States have adopted the plan of choosing their delegates to conventions by direct primary, the next logical step (though its adoption is now very problematical) is to provide for the nomination of a Presidential candidate by the direct popular vote of the entire party. This would soon result in a direct vote of the whole country for President and thus eliminate the antiquated electorial college (q.v.). In most cities the direct primary has been discarded in order to eliminate national party politics and in its place non-partisan primaries and nomination by petition only have been substituted. See ELECTIONS.

The earliest system of direct selection of candidates was the Crawford County system used in Pennsylvania in the sixties, but though this was adopted in the Southern, Central and Western States, its use was not general until the nineties. Minnesota adopted the direct primary for Hennepin County in 1899 but Wisconsin by her law of 1903 was the first State to adopt this method for all nominations. The State-wide direct primary is now used in almost all of the States; it was adopted by Oregon in 1904; by Iowa, Missouri, North Dakota, South Dakota, Nebraska and Washington in 1907; by Ohio, Kansas and Oklahoma in 1908; by California, Nevada, Idaho, Tennessee, Michigan and New Hampshire in 1909; by Arizona in 1909 and 1912; by Illinois, Maryland and Colorado in 1910; by Wyoming, New Jersey, Massachusetts and Maine in 1911; by Minnesota, Virginia, Kentucky, Mississippi, Louisiana and Montana in 1912; by New York, Pennsylvania and Florida in 1913; and by Vermont, Indiana and West Virginia in 1915; while in South Carolina, Georgia, Alabama, Arkansas and Texas it is conducted under the rules of the Democratic party but has not been established by statute for all parties. See BALLOT; CONVENTION, POLITICAL; CAUCUS; ELECTIONS.

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No. 3, pp. 84–94, Philadelphia 1906); Woodburn, J. A., 'Political Parties and Party Problems' (rev. ed., New York 1914).

PRIMARY, Presidential Preference, a method adopted by some States of applying the direct primary to the choice of delegates to national political conventions. A widespread belief that the national conventions, in their entire membership, had not been truly representative of the party voters and did not reflect the preference of the majority resulted in the enactment of laws for the choosing of delegates directly by the party voters in official primaries. The laws passed by the States vary regarding the degree of directness with which the preference is expressed and the measure of certainty of its being carried into effect. Under the California and South Dakota laws, a number of candidates, corresponding to the number of delegates to which the State is entitled, may file a nominating petition as a group, pledged to the interest of a given candidate for President. These names are placed on the ballot together and the voter may by one mark cast his ballot for the entire group at once. Before a group may be placed on the ballot, the law requires that not less than one nor more than three of the persons named reside in the same Congressional district; and the group must also have the endorsement of the Presidential candidate whose cause it has espoused or of a State organization possessing his confidence. In Illinois, New Jersey, New Hampshire and Ohio the Congressional district is the unit for electing delegates. In Illinois the candidate for delegate must file with his nomination petition a statement of his preference for President or a statement that he has no choice; and on the official primary ballot the preference or lack of preference is printed beneath the name of each candidate. In Ohio the delegate files a first and second choice for President, both of which are printed on the ballot, but the candidate as an alternative may state that if elected he will support for President the candidate receiving the majority of the preference votes. The New Hampshire law simply permits candidates for delegate or delegates at large to pledge that if elected they will vote at the national convention for a given candidate for the Presidential nomination as long as his name remains before the convention. The delegates from Oregon and Montana are elected at large, but in order to secure minority representation the voter is allowed to cast his ballot for one person only as a delegate. Those candidates receiving the largest number of votes are declared elected. A direct Presidential preference vote is held at the same time and candidates for delegate pledge themselves under oath to accept the popular choice. Delegates from Pennsylvania and North Dakota are bound by the preference vote but the vote is not binding on delegates from Massachusetts, Minnesota, Nebraska, Texas and Wisconsin. The Iowa ballot contains the names of candidates for President and Vice-President, party national committeemen, delegates at large, district delegates, and alternates of the last two. The voter is also called upon to decide by a vote of yes or no whether district delegates to the national convention shall be instructed by the vote of the State at large or by the vote of the Congressional district. Maryland combines a preference vote with an election of delegates by a State convention. The county delegates to the State convention are instructed by the voters of the county to support a certain candidate and must do so as long as this candidate has the support of nine counties. The Presidential candidate receiving the votes of a majority of the delegates becomes the choice of the State party and must be given the support of the State delegation at the national convention. A majority of the Presidential primary laws are mandatory. Since Presidential primaries are held under the regular primary laws, candidates for delegate, in order to have their names placed upon the ballot, must file nominating papers. Likewise in most of the States having such laws, Presidential candidates, either personally or by duly authorized State organizations, must file petitions signed by a designated percentage of their party supporters in the State. In 1910 Oregon extended her primary law to Presidential nominations and in 1913 applied direct nomination to the office of national committeemen; she was followed in 1911 by New Jersey, North Dakota, Nebraska and Wisconsin; in 1912 by California, Illinois, Maryland, Massachusetts, South Dakota, Montana and Michigan; in 1913 by New Hampshire, New York, Pennsylvania, Ohio, Minnesota and Iowa; in 1914 by Texas, and in 1915 by Vermont, Indiana and North Carolina.

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PRIMARY BATTERIES. See BATTERY.

PRIMARY ELECTIONS. See ELECTORAL QUALIFICATIONS; CONGRESS.

PRIMARY ROCKS, formerly applied by geologists to the earliest rocks, including particularly those owing their present state to igneous agency. Gneiss, various schists and granite were so regarded. At the present time primary is used as equivalent to Palæozoic (q.v.).

PRIMARY VOLTAIC CELL. See ELECTRICAL TERMS.

PRIMATE, since the 4th century of the Christian Church, the title assumed by the bishop of the capital of a province, and hence equivalent to metropolitan or exarch. The Council of Chalcedon decreed that the primacy, or "first place before all," was to be accorded to the "archbishop of Old Rome." In Africa the title belonged to the bishop of Carthage. In other parts of Christendom an attempt was made to distinguish between primates and metropolitans as early as the 9th or 10th century, for one of the capitularies of the early French kings ordains that no metropolitan shall assume the title of primate unless he has a just claim to that honor; and in the 11th century the popes expressly reserved the title only for the leading metropolitans in different countries, and endeavored to subordinate the other metropolitans to them. The resistance to this arrangement was, however, so general and emphatic that the dignity of primate remained little more than a nominal one, entitling the holder of it merely to precedence on public occasions. In France the archbishop of Lyons was appointed primate of the Gauls by Gregory VII in 1079, and the archbishop of Rouen is also primate of Normandy. In the German Empire the archbishop of Salzburg was primate. In Hungary the archbishop of Gran is primate; in Bohemia that of Prague; in Spain that of Toledo. In Poland the primacy belonged to the see of Gnesen. None of these bishoprics any longer retain primatial rights of jurisdiction excepting that of Gran. The office belonged of right to the papal legate, who was president of the Senate and censor of the king. He governed the state during an interregnum, had a court, guards, and a marshal of the palace, and in general enjoyed the highest privileges. In the Church of England both the archbishops still retain the title of primate, the archbishop of Canterbury being distinguished as the primate of all England and the archbishop of York as the primate of England. In the Protestant Episcopal Church of Ireland the archbishop of Armagh is primate as formerly when the church was established.

PRIMATES, the name given by Linnæus to his highest order or group of the *Mammalia*, which included the bats (*Cheiroptera*), the apes, monkeys, and lemurs (*Quadrumana*), and man (*Bimania*). By common consent of zoologists the bats have been removed, leaving the monkeys, lemurs and man as a fairly homogeneous group. Formerly the definition of this order was comparatively easy, but owing to numerous recent palæontological discoveries an almost unbroken series of forms between the lemurs and the *Insectivora* is now known, and the interrelationships between the former and the higher apes, and of the latter with one another and with man, have been shown to be more complex than was anticipated. Leaving out of account the prelemurine fossils, the order may be characterized as follows: There are always complete milk and permanent dentitions, the latter having the various kinds of teeth well differentitated and usually the following formula: Incisors, $\frac{2}{2}$; canines, $\frac{1}{1}$ premolars, $\frac{2}{2}$ or $\frac{3}{3}$, and molars $\frac{3}{3}$ or $\frac{2}{2}$ (rarely). Occasionally there is the loss of an incisor, premolar or canine. The molars are of the simple quadritubercular grinding type, and the premolars are still simpler. In all cases the orbit is surrounded by a bony ring and frequently separated from the temporal fossa by a plate of bone. The clavicles are well developed, the radius and ulna and the tibia and fibula (except in one case) are never coalesced, the scaphoid and lunar bones of the wrist are distinct, and the pollex and hallux (except the latter in man) form opposable thumbs. With a few exceptions among the lemurs and marmosets, the digits are all terminated by flat nails. Except in isolated cases the stomach is always simple, there are two pectoral mammæ and the testes are contained in a scrotum. Concerning the subdivision of the order in suborders and families there are several opinions; but the customary recognition of the sub-order *Prosimiæ* or *Lemuroidea* for the lemurs and their allies, of *Quadrumana* for the monkeys, baboons and marmosets, and of *Anthropomorpha* for the apes and man will serve present purposes. Consult Hartman, 'Anthropoid Apes' (1886); Forbes, 'Handbook of Primates' (1896–97).

PRIMATICCIO, Francesco, frān-chĕs'kō prē-mā-tĕt'chō, Italian painter: b. Bologna, 1504; d. France, 1570. He was a pupil of Innocenzo da Immola and Bagnacavallo, and began in 1525 to study under Giulio Romano. In connection with several of the pupils of the latter he painted the Palazzo del Tè, in Mantua, from Giulio's designs. Through the recommendation of Frederick, Duke of Mantua, Primaticcio was engaged by Francis I of France in 1531 to decorate the palace of Fontainebleau. To his influence were owing not only numerous paintings in fresco and works in stucco which the king caused to be executed, but several branches of painting, as, for instance, enamel painting, and designs for tapestry, were carried to greater perfection through his exertions. Francis sent him to Italy to purchase antique statues, and casts of famous works of art. On the death of Rosso, the royal painter, Primaticcio succeeded to his post, and Francis II appointed him in 1559 superintendent of the royal buildings. He furnished the designs of several architectural works, among them of the tombs of Francis I and Henry II. His works at Fontainebleau, however, gained him more reputation. His was a clever, facile pencil, but he was the slave of mannerism and meretriciousness, and that fluent but artificial elegance which remained so long the characteristic of French art. His frescoes and stucco work have been almost all destroyed; we can only judge of their quality from engravings, and there are no oil-paintings which can with certainty be ascribed to him; even the authenticity of 'The Continence of Scipio' now in the Louvre is sometimes doubted.

PRIME, Edward Dorr Griffin, American Presbyterian clergyman and religious journalist: b. Cambridge, N. Y., 2 Nov. 1814; d. New York, 7 April 1891. He was graduated in 1832 from Union College, and from Princeton Theological Seminary at Princeton in 1838. He filled several pastorates, including that of the Eighty-sixth Street Presbyterian Church, New York, and contributed articles to the *New York Observer* under the signature "Eusebius." With his brother, S. I. Prime (q.v.), he edited the paper 1854–85, and continued to edit it a year longer after his brother's death. He published 'Around the World' (1872); 'Forty Years in the Turkish Empire' (1875); 'Notes, Genealogical, Biographical and Bibliographical of the Prime Family' (1888), etc.

PRIME, Samuel Irenæus, American Presbyterian clergyman and editor: b. Ballston, N. Y., 4 Nov. 1812; d. Manchester, Vt., 18 July 1885. He was graduated from Williams College in 1829, entered the Princeon Theological Seminary and in 1833 was ordained in the ministry. He was in charge of pastorates at Ballston Springs, N. Y., 1833–35; at Matteawan, N. Y., 1835–40. In 1840 he became editor of the *New York Observer* and continued as such until his death, with the exception of a period in 1849 when he was secretary to the American Bible Society, and another in 1850 when he edited the *Presbyterian*. He was one of the founders of the Evangelical Alliance of America in 1866 and its corresponding secretary until 1884, was vice-president of the American Tract Society and was prominently connected with various religious and educational institutions. From 1854 he was a regular contributor to *Harper's Magazine*, where his «Editor's Drawer» became famous, and in 1858 his literary earnings enabled him to purchase the *Observer*, which he made the leading organ of his denomination. His 'Power of Prayer' (1858) reached a sale of 175,000 copies in United States and England and was translated into French, Dutch and Tamil. Among his other books are 'The Old White Meeting-House' (1845); 'Travels in Europe and the East' (1855); 'Letters from Switzerland' (1860); 'Kirwan' (1870); 'Irenæus Letters' (1st series, 1880; 2d series, 1885), etc.

PRIME, William Cowper, American journalist: b. Cambridge, N. Y., 31 Oct. 1825; d. New York, 13 Feb. 1905. He was graduated from Princeton in 1843, studied law, was admitted to the bar in 1846 and engaged in law practice in New York in 1846–61. In 1861–69 he was editor-in-chief of the New York *Journal of Commerce*, was first vice-president of the Metropolitan Museum of Art after 1874 and professor of the history of art at Princeton after 1884. He devoted much time to literature and was an authority on numismatics and Egyptian antiquities. Among his publications are 'The Owl Letters'; 'The Old House by the River' (1853); 'Boat Life in Egypt and Nubia' (1857); 'Coins, Medals and Seals' (1860); 'I Go A-Fishing' (1873); 'Holy Cross' (1877); 'Along New England Roads' (1892); 'Among the Northern Hills' (1895), etc.

PRIME. See CANONICAL HOURS.

PRIME MINISTER, the title of the premier, secretary of state or other officer of state, who in most European countries, at the summons of the sovereign, has succeeded in forming an administration, of which he is the head and which may be named after him. Those who accept office under him are assumed to agree with his policy in the main. Though each member of the ministry administers his own department independently of his colleagues, all important departmental matters are submitted to him, the most important being brought before the whole ministry, and no appointment of moment is made or recommended to the Crown without his knowledge and concurrence. His own patronage is very extensive. In forming an administration, he selects all those who are to fill the various offices, though the appointments are subject to the sovereign's approval. In England it is on his advice that as vacancies occur the archbishops, bishops and deans and the highest judges are appointed and over 100 Crown livings are filled; and on his recommendation that the most envied temporal titles and honorable distinctions — peerages, baronetcies and the Garter, for example — are conferred and such high appointments as the lord-lieutenancy of Ireland, the viceroyalty of India, the principal ambassadorships and colonial governorships and lord-lieutenancies of countries, are made by the Crown. He is the leader of the House of Parliament, of which he is a member. Yet as prime minister he enjoys no legal precedence over his colleagues, his official existence being indeed not recognized by statute. In European governments the prime minister, or premier, is usually charged with the management of diplomatic affairs and in this respect resembles the Secretary of State of the United States.

PRIME NUMBER, an integer indivisible by any number save itself and unity, that is, one which cannot be factored; such number are 1, 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, etc. They occur very frequently among the lower numbers and begin to be scarce among the higher thousands. The determination of the prime numbers has remained a mere matter of rejecting factorable numbers; this is done in a quasi-mechanical way by the table called Eratosthenes' sieve, upon which all the numbers to be tested are written at equal intervals and covered in succession by gridiron-like slips of paper, covering first all multiples of 2 (the even numbers may better be omitted at the start), then all multiples of 3 and so on. But even with the modern theory of numbers no rule has been laid down for the periodicity of the occurrence of the prime numbers. Gauss discovered in 1810 that the number of primes less than x was approximately $\int_2^x \frac{dx}{\log x}$; Chebicheff gave a formula for the determination of the number of prime numbers between any two primes; in a monograph dated 1859, Riemann gave an even more exact formula and a very complicated one, also dependent on the integral used by Gauss. The theory of numbers has also shown that «every prime number is (in general in more than one way) a sum of four squares,» but this is equally true of other numbers, inasmuch as (1) every factorable number is the product of two prime numbers and (2) the sum of four squares into the sum of four squares is always a sum of four squares. There is a theorem of Goldbach to the effect that «every even number is the sum of two prime numbers.» Factor tables have been made for all numbers between 1 and 10,000,000 in the attempt to codify the prime numbers; by reference to them it may be instantly discovered whether a given number is prime or not.

PRIMERO, prĭ-mē'rō, or **PRIME,** a card game very popular in England in the 16th century, but now obsolete. The same or a very similar game was played in Italy under the name *primiera* and in France under the names *prime, ambigu*, etc. Primero belonged to the family of games of which the old post and pair and the more modern brag and poker are members.

PRIMITIVE ART. See ABORIGINAL ART.

PRIMITIVE METHODIST CHURCH, a Christian community known previously to 1902 as the Primitive Methodist Connection. It originated with Hugh Bourne (1772–1852), a millwright of Stoke-on-Trent, England, who joined a Methodist society at Burslem, but whose open-air preaching, prayer and singing, the forerunner of the «camp-meeting,» a departure from Wesley's methods, led to his expulsion from the Wesleyan Connection. With William Clowes and some strong supporters, they built a chapel at Tunstall in July 1811, and in February 1812 adopted the name of «Primitive Methodists.» Popularly they were long known both as «Clowesites» and «Ranters» (q.v.). In 1860 when they celebrated their jubilee at Tunstall, the Conference reported in Great Britain 2,267 chapels, 675 ministers, 11,384 local preachers, 132,114 members, 30,988 teachers and 167,533 students, with increasing numbers throughout the British colonies. From 1885 on a movement developed to form the «Connection» into a «Church» which was accomplished in 1902 supporting numerous schools and missions with the *Holborn Review* as its special periodical. The Primitive Methodists are represented in the United States by 94 churches, 74 ministers and 8,600 communicants.

PRIMITIVE SOCIETY AND DEMOCRACY. See DEMOCRACY, HISTORY OF.

PRIMITIVE THOUGHT. See MYTHOLOGY.

PRIMOGENITURE, prī-mō-jĕn'ĭ-tūr, seniority of birth and the right by law of the eldest son of a family (and of those who derive through him) to succeed, in cases of intestacy, to the father's real estate, to the absolute exclusion of the younger sons and the daughters. This rule, system or right prevails in Great Britain; but, following the example of revolutionary France, most of the countries of continental Europe have abolished it. Several exceptions to the rule are allowed in the United Kingdom, but, these apart, whenever a man dies intestate leaving real estate, his eldest son is entitled to the whole of it and the rest of the children not otherwise provided for out of the personalty are left without anything. If there is no male heir, the daughters succeed, not singly and in the order of seniority, but jointly. In the United States no distinction is made in the descent of estates to lineal descendants.

PRIMROSE, a popular name for many garden and wild plants, among which the following are probably the best known: Evening primrose (*Œnothera biennis*, etc.); Arabian primrose (*Arnebia cornuta*); Cape primrose (*Streptocarpus* spp.); and various species of the genius *Primula*. This last consists of about 150 species of mostly perennial herbs with rosettes of leaves of various forms (especially under cultivation), and salver-shaped, generally showy, white, yellow, pink, lilac and purple flowers borne in clusters upon scapes. They are natives of the north temperate zone, one species South American, one Javanese, and generally common in mountainous countries. About 40 are Himalayan; a dozen North American. They may be divided into five groups according to their uses as ornamental plants for which purpose they have long been popular. The auricula (q.v.) and the alpine primroses, neither of which are widely popular in America, the former because the climate is believed to be against them, the latter because alpine gardens have not become popular. Third, the yellow or purple-flowered outdoor species such as *P. imperialis* and *P. japonica*, which with winter mulching are grown in the Northern States; the polyanthus group, which contains the oxlip (*P. elatior*) and the cowslip (*P. officinalis*), very popular, fully hardy favorites blooming in early spring; and the greenhouse primroses, such as the Chinese (*P. sinensis*), *P. obconica* and *P. forbesi* (baby primrose), all of which are widely popular houseplants. Propagation is usually by seed, though varieties that do not come true to type may often be propagated by division or cuttings. Seed should be sown soon after its collection, since it quickly deteriorates if allowed to become dry. In general, primroses succeed best in deep, well-drained, loose, rich loam not exposed to the glare of the sun. The polyanthus kinds may be grown in cold frames during the winter, set in beds in early spring, removed after flowering to shady moist situations for the summer, divided in the autumn and planted in cold frames again. The yellow-blossomed kinds are favorites with florists. The greenhouse kinds are sown under glass in early spring and kept growing steadily in flower pots of increasing sizes until the 6-inch size is reached in autumn when they should begin to blossom. The soil for them should be light, loose and rich both in plant food and humus. At the primrose shows there are often 200 to 300 distinct varieties on exhibition, mostly of *P. sinensis*, which has developed many remarkably beautiful forms attractive in foliage as well as flower.

PRIMROSE DAY, in England the anniversary of the death of Benjamin Disraeli, Lord Beaconsfield (q.v.), 19 April 1881. Every member of the Primrose League (q.v.) wears a bunch of primroses on that day in token of alliance with, and support of, the objects of the league.

PRIMROSE LEAGUE, an English political organization founded in 1883 by members of the Fourth party (consisting of Lord Randolph Churchill and others) in memory of Benjamin Disraeli (q.v.), Earl of Beaconsfield. The primrose, as Lord Beaconsfield's favorite flower, was selected as the emblem and name of the league. The members include knights, dames and associates, and are divided into groups called habitations. In the propaganda to perpetuate Lord Beaconsfield's principles of world-wide federation, less reliance is placed on discussion, lectures, etc., than on the appeal to the social elements in human nature. The large membership is due mainly to the efforts of female members.

PRIMULA. See PRIMROSE.

PRIMUM MOBILE, prī'mŭm mŏb'ĭ-lē, *in astronomy*, the ninth or highest sphere of the heavens, whose centre is that of the world and in comparison with which the world is but a point. This the ancients supposed to contain all other spheres within it and to give motion to them, turning itself, and all of them, quite round in 24 hours. See ASTRONOMY.

PRINCE, Morton, American physician: b. Boston, Mass., 21 Dec. 1854. He was graduated at Harvard in 1875, taking his M.D. there in 1879, and since 1880 has been engaged in practice in Boston. Since 1885 he has been physician for nervous diseases at the Boston City Hospital; and in 1902–12 he was professor of nervous diseases at Tufts College, then becoming professor emeritus. Since 1906 he has edited the *Journal of Abnormal Psychology*. Author of 'Nature of Mind and Human Automatism' (1885); 'Disassociation of a Personality' (1906); 'The Unconscious' (1913).

PRINCE, Thomas, American clergyman and historian: b. Sandwich, Mass., 15 May 1687; d. Boston, 22 Oct. 1758. He was graduated from Harvard in 1709, studied in England and was pastor of a church at Combs, Suffolk, England, 1711–16, then returned to Massachusetts accompanied by several of his congregation. On 1 Oct. 1718 he was ordained pastor of the Old South Church, as colleague of the Rev. Joseph Sewall. In 1727 appeared the first volume of his 'Annals of New England,' materials for which he had collected with great care while in England. It was approved by the legislature, but owing to the indifference of the public was never completed. He published also sermons, several works on phases of the early history of New England and 'The New England Psalmbook Revised and Improved' (1758). He made a valuable collection of books by New England authors and manuscripts connected with New England records; this was partially destroyed by the British in 1766, but the remainder was presented to the Boston Public Library in 1860.

PRINCE (from Lat. *princeps*), a title which means literally one who holds the first place. In ancient Rome the title of *princeps senatus* was given to the leading senator, being the one whose name came first in the list and who had the right to record his vote first. In modern times the title of *prince* (or *princess*) is given to all sovereigns generally, as well as to their sons and daughters and their nearest relations. In England, while not generally used, the title is applied in strict heraldic language, as a mode of address to dukes, marquises and earls. In Germany there is a class of sovereigns, ranking next below the dukes, who bear the title of prince as a specific designation. The members of royal families are there called *Prinzen* instead of *Fürsten*, to distinguish them from the class to whom the latter title more particularly belongs. On the Continent there are ancient families not immediately connected with any reigning house who bear the title of prince. Formerly, in France, duke was a title superior to prince. In England the only case in which the title is a territorial one is that of the Prince of Wales (q.v.). See NOBILITY.

PRINCE, The ('Il Principe'), by Niccolò Machiavelli (written 1513, published in a Latin version 1523, and in the original Italian 1532), holds a high place both in history and in literature. Historically the chief document of the centralizing and nationalizing movements of Renaissance Europe, it was produced by the country that most conspicuously failed to centralize and to nationalize. The Wars of the Roses had turned England from feudalism to the strong Tudor monarchy; Louis XI in France had subdued his great nobles and established a national postal system and a royal standing army; Ferdinand and Isabella had united Castile and Aragon, and at the expense of Moors, Jews and heretics had purchased the solidarity of Spain; but Italy, long after these national consolidations, continued to suffer from the ambitions of local despots and condottieri, and from the incessant struggle of secular political bodies with the Pope. Disunited, she was again and again the prey of foreigners; Charles VIII of France in 1494 had taken her without bloodshed, and, as the saying was, "with chalk," the chalk with which his unrestricted soldiers marked their quarters. It was no wonder that Machiavelli, Florentine historian, diplomatist and patriot, was looking about for the strong man who should liberate and unify Italy. For this imaginary personage 'The Prince' is a textbook in the methods of acquiring and governing a state.

Cesare Borgia had almost carved out an Italian kingdom when his plans were frustrated by the death of his father, Pope Alexander VI, together with his own sickness in that emergency, and his neglect to prevent the election of Julius II. Both his success and his failure made him an ideal example for the ideal Prince to observe. His success was due to ruthless energy and cunning, an imposing personality and boundless self-assertion. His failure was due to adverse chance, which struck just before he had quite consolidated his power, and to his own want of adaptability to his bad luck. The Prince, therefore, first should exercise *virtù*, in which Machiavelli sums up all the forces of the strong individual; and, secondly, should adapt himself to *fortuna*, in which are summed up all the forces of what we now call the environment. When fortune changes, the Prince must change too, lest she ruin him. He must, as Bacon wrote under Machiavelli's influence, "make the wheels of [the] mind concentric and voluble with the wheels of fortune." The keeping of his promises, for example, after circumstances have changed, may clearly be inexpedient. Nor is his *virtù* to be any more "virtuous" than his attitude toward shifting fortune. He may use any degree of guile and cruelty to attain his end; but these must be judiciously employed — cruelty, for example, sharply and on an egregious scale at the moment of the *coup d'état*, not vacillatingly and in small doses throughout the reign; for the latter policy, both a sign and a cause of weakness, merely makes the Prince despised and hated instead of feared, and may hasten his fall. Like the dishonoring of women, it should be avoided because, by setting large numbers of persons against the Prince, and by making him lose glory, it imperils his success. The sanctions of his conduct are thus wholly human: success and fame among men.

Machiavelli evidently feels that the need for order and unity in the state ought to outweigh whatever ethical scruple the Prince may entertain. Just here is where 'The Prince' becomes the classical document of *Machtpolitik* and *raison d'état*. For in establishing order the Prince must of necessity not only police his own city-state, his Rimini or Perugia, but also acquire other city-states to be consolidated with it into a principality — else the old disorders between states will be kindled anew. Hence Machiavelli's policy of the strong unethical hand must be pursued both within and between states; it is not only intranational but international. The implication is that there is no room for morality either between individuals engaged in the process of forming possible states — i.e., in the process of competing for power, or between states — which are tacitly assumed to be continually struggling with each other to see which shall absorb the others. Just where, if anywhere, this ruthless competition is to cease — just how large the orderly group or principality must be before it can stop expanding for the preservation of its particular type of order (*Kultur*) — 'The Prince' does not tell us; it could not, after all, anticipate the 19th and the 20th centuries.

What makes it permanently interesting, however, is precisely the perpetual recurrence of these questions. In the 18th century, for example, Frederick the Great as Crown Prince writes an *Anti-Machiavel,* which, one is not surprised to find, never seriously affected his policy as king; in the 19th century Machiavelli becomes one of the heroes of *Italia Unita.* In the 19th century, too, political Machiavellianism is strongly supported by a false application of the new competitive theory of evolution — evolution by the survival of those organisms which are stronger than others (*Virtù*), and which fit, or can make themselves fit, their environment (*Fortuna*). This biological false analogy strikes back into actual politics in the Machiavellianism of the 20th century war. We are still confronted with a concept of the state which, assuming that sheer power is its end, aims not only to control all within the national territory, but to take in ruthlessly from without whatever the sovereign deems necessary to his quiet.

From being merely the document of a moment in history 'The Prince' has thus come to be the textbook of continuing political practice, and a perennial source of biological, political and ethical theory. Its method, indeed, which at times seems purely inductive, as based upon the examination of historical facts, without illusions, prepossessions or hypotheses, is based also upon the generalizations of classical writers, and proves in point of fact highly deductive and dogmatic. It assumes, for example, that men are naturally bad until compelled by the legislator or Prince (Carlyle's «hero») to be good; it supposes history to move cyclically; and in the person of the Prince, from whom a moral sense is omitted, it frames a political man who is quite as much an abstraction as is the «economic man» of the *laissez-faire* school. So far from being merely factual, 'The Prince' embodies rather pure and universal types. Unhampered by repression or apology, it sets forth, expressly or impliedly, human tendencies that belong to no one time or place — the adoption of success as the criterion of conduct; the adoption of «the verdict of history» instead of the verdict of ethics, especially in international relations; the implication that what makes ethics is the state itself; and, as has been already indicated, man's striving for fame, his adaptation to his environment or *fortuna* and his natural self-assertiveness or *virtù.*

To this universal content, as well as to its lucid straightforward classic style, are due 'The Prince's' literary eminence and influence. Of the latter it will be possible to mention only a case or two from English literature. Marlowe's 'Tamburlaine' and Shakespeare's 'Richard III' belong to a type of Elizabethan tragedy which takes for its theme the *virtuoso* or individualist on his career of rule and ruin. This theme, though derived, in all probability, from the mediæval tragic theme of the Fall of Princes, is strongly tinged by Machiavelli, with whom Elizabethan dramatists were well acquainted. Bacon's works, too, are under strong Machiavellian influence — his conception of man's dealings with his fellow-man in politics, and with nature in inductive and productive science, being that of «morigeration,» or pliancy to the environment.

The best edition of 'The Prince' is that by L. Arthur Burd, Oxford, 1891, with an introduction by Lord Acton, and valuable essays, notes and bibliography. There are convenient modern translations by Ninian Hill Thomson (3d ed., Oxford 1913), Luigi Ricci ('The World's Classics') and W. K. Marriott ('Everyman's Library').

SAMUEL LEE WOLFF.

PRINCE ALBERT, a town in North Saskatchewan, Canada, 542 miles northwest of Winnipeg, situated on the river of that name, on the Grand Trunk Pacific Railway and four branches of the Canadian Northern line. It has a Roman Catholic cathedral, Anglican pro-cathedral and Presbyterian, Methodist, Baptist and Lutheran churches, public and separate schools and colleges and hospitals. The industries include three large lumber companies, cold storage, abattoir and packing plants, planing mills and granite works; and the neighborhood, in addition to its suitability for stock raising, has areas of fine clay suitable for pottery and bricks, and 2,000 square miles of spruce and poplar extend northwards of the city. Pop. about 6,158.

PRINCE ALBERT LAND, Canada, an Arctic island of the Franklin District, separated from the Mackenzie District by Coronation Gulf, Victoria, Dease and the Dolphin and Union straits, along the Northwest Passage. Its southern and southeastern peninsulas are known respectively as Wollaston Land and Victoria Land; Prince Albert Sound is a deep inlet on its eastern coast, and Collinson Inlet another on the north coast. It has not been fully explored.

PRINCE EDWARD ISLAND, Canada, an insular province of the Dominion, and the smallest in area and population, in the southern part of the Gulf of Saint Lawrence, separated east to west from Cape Breton Island, Nova Scotia and New Brunswick by the curving Northumberland Strait, from 10 to 30 miles wide. The greatest length of Prince Edward Island on a curve is about 150 miles, breadth varying from 4 to 34 miles, area, 2,184 square miles; it is the smallest province of the Dominion. The capital is Charlottetown (q.v.). which is connected by rail with all the principal points of the island. Other towns are Summerside, Georgetown and Souris.

Topography, Physical Features and Natural Resources.— The coast-line presents a remarkable succession of large bays and projecting headlands. Of the latter the most prominent are North Cape on the northwest, West Cape on the southwest and East Cape on the northeast; the largest bays are those of Richmond on the northwest, Egmont and Bedeque on the southwest, Hillsborough on the south and Cardigan on the east. The surface undulates gently, nowhere rising so high as to become mountainous, or sinking so low as to form a monotonous flat. The soil consists generally of a light reddish loam, sometimes approaching to a strong clay, but more frequently of a light and sandy texture. The prevailing rock is a Triassic reddish sandstone. The island is well watered by numerous streams and springs. At one time the whole island was densely covered with beech, maple, fir and other trees, and it is still well wooded, only about two-thirds of the area having been cleared. There are no minerals of any importance. The fisheries are valuable; the total value of the catch was $933,682. The most valuable item is the lobster, followed by the mackerel, cod, herring and hake.

Climate.— The climate is much milder than that of the adjoining continent, and the air, generally free from the fogs which spread along the shores of Cape Breton and Nova Scotia, is remarkably salubrious. During the greater part of July, August and September the thermometer during the hotter hours of the day seldom varies more than from 75° to 80° F.

Agriculture.— The island is eminently agricultural and pastoral. Of its total area of 1,397,991 acres, very little is unsuitable for cultivation, but little more than half the area is under cultivation for field crops. The principal products are oats, wheat, potatoes, turnips, apples, etc. In 1916 7,413,000 bushels of oats were raised, of a value of $4,522,000; 578,000 bushels of wheat of a value of $879,000; 6,386,000 bushels of potatoes, of a value of $3,321,000; and 338,000 tons of hay and clover of a value of $3,907,000. Good breeds of horses, cattle, sheep and swine are reared, and dairy farming has become a thriving industry; large quantities of cream, butter and cheese being manufactured, the dairy products in 1916 being valued at $593,659. A recent and flourishing industry is the breeding in captivity of the silver black fox.

Manufactures and Commerce.— The manufactures are chiefly confined to linen and flannels for domestic use; there are also several tanneries, boot and shoe factories, manufactures of tobacco, condensed milk, pork-packing establishments and some shipbuilding. The exports for the year to 31 March 1917 were valued at $589,218, and the exports at $838,647.

Shipping and Communications.— In 1916 the shipping of the province was 130 sailing and 28 steamships, aggregating 11,518 tons, the tonnage of the steamers being 3,495. The Prince Edward Island Railroad, built by the Dominion government, connects the principal points of the island and has a length of 276 miles and a car-ferry service gives connection with the mainland. Telephonic communication extends throughout the island, which is also traversed in all directions by good coachroads.

Government.— The province is administered by a lieutenant-governor nominated by the Crown, who appoints an executive council of eight members, with a legislative assembly of 30 members, half elected on a property qualification, and half on a popular franchise. The province was admitted into the Dominion of Canada in 1873, is represented in the Dominion House of Commons by four members, and has four representatives in the Senate.

Education and Religion.—Adopted in 1851 the free school system is administered by a government superintendent and council. In 1916 18,362 pupils were enrolled in 476 schools conducted by 595 teachers, and $244,572 were expended for education. The membership of the principal religious denominations in 1916 was, Roman Catholics, 41,994; Presbyterians, 27,507; Methodists, 12,209; Anglicans, 4,939; Baptists, 5,905.

History.— Sebastian Cabot is supposed to have sighted Prince Edward Island after discovering Newfoundland in 1497, but with more likelihood the honor is also assigned to Jacques Cartier (1634). It appears on Champlain's map under the name of Saint John and it was later included by the French in their vast and undefined territory of New France, and in 1663 was granted on a feudal tenure to a Sieur Doublet, a French naval officer. Little progress was made in settling the island till after the Peace of Utrecht in 1715, when its fertility attracted numbers of settlers from Cape Breton. It was taken by the British in 1745; restored by the Peace of Aix-la-Chapelle; again fell into British possession after the capture of Louisbourg in 1757, and its inhabitants shared in the Acadian expulsion. It became a dependency of Nova Scotia, was partitioned among a small body of proprietors in 1767 and was erected into a separate province in 1769. In 1862 responsible government was conceded. In 1873 the island was admitted into the Dominion of Canada, and in 1875 a scheme of land purchase expropriated the proprietors. Pop. (1901) 103,259; (1911) 93,727, of which 98.37 per cent were Canadian born. The density per square mile, 42.91, is the highest among the provinces of the Dominions; but the population is declining. Consult Campbell, 'History of Prince Edward Island' (1875); Dawson and Harrington, 'Geological Structure and Mineral Resources of Prince Edward Island' (1882–84).

PRINCE EDWARD ISLAND RAILWAY (Government Railways). It was one of the conditions of the entrance of Prince Edward Island into the Dominion of Canada, which took place 1 July 1873, that the railway under contract and in course of construction for the government of the island should become the property of the Dominion. This railway extended from Charlottetown, the capital, westward to Tignish and eastward to Georgetown, a distance of 195 miles. Other lines have since been constructed, as follows: Charlottetown to Murray Harbor, 48 miles; Montague to Montague Junction, six miles; Emerald Junction to Traverse, 12 miles; Halmira Junction to Elmira, 10 miles: the Vernon Loop, four miles — giving a total of 275 miles. The gauge of the railway is three feet six inches. The cost of the railway and equipment to 30 June 1914 was $8,920,623. The gross earnings for year to 30 June 1915 were $412,520, of which $212,622 were for passengers, and $186,560 for freight. The rolling stock consists of 22 locomotives, 43 passenger train cars and 501 freight cars, besides service cars, etc.

A daily steamer service is maintained between Charlottetown and Pictou, and between Summerside and Point du Chene during the season of navigation, and passengers and freight are carried by ice-breaking steamers during the winter season between Georgetown and Pictou.

PRINCE OF INDIA, a romance by Lew Wallace, published in 1893. The ‹Prince of India› is the Wandering Jew.

PRINCE AND THE PAUPER, The, a historical tale by Mark Twain (Samuel Langhorne Clemens) published in 1881. The plot hinges on the remarkable resemblance of a poor street boy to the young English prince, afterward Edward VI.

PRINCE RUPERT, Canada, sea-port and capital of the electoral district Comox-Atlin, British Columbia, on the north end of Kaien Island, about 550 miles northwest of Vancouver and 3,860 nautical miles east of Yokohama, and the Pacific Coast terminus of the Grand Trunk Pacific Railway. It has anchorage for the largest ships, and a marine station and quarantine hospital are located here. It has a hydro-electric plant, modern waterworks and telephone system. Industries include chiefly those allied to the lumber trade, and there are large cold-storage plants. Pop. (1911) 4,184; (1915) estimated 6,500.

PRINCE RUPERT'S DROPS, pieces of glass which have been cooled very suddenly from the melted state by having been dropped into water. They are called *larmes bataviques* (Dutch tears) by the French. The outside of the drop of melted glass is instantaneously solidified by the water, while the inside cools gradually, so that the outside shell is acted upon by very great stresses due to contraction of the internal portions when cooling. In fact the drop is kept in a state of excessive strain by stresses in unstable equilibrium; and if this equilibrium is destroyed by scratching the surface with a diamond, or breaking off the tip of the tail, the strained particles are violently released, and the mass is instantly pulverized. Heat is produced during the pulverization of the drop. This explanation applies to the falling out of the bottom of the very thick flask of unannealed blown glass called the «Bologna flask,» when its surface is scratched. Glass articles — articles of any brittle material—ought to be cooled very slowly from the melted state. The process of slow cooling to which such articles are subjected is called annealing. To anneal glass it is placed in a large furnace which has nearly a red-heat at one end and a lower temperature than 100° C. at the other; after the glass has been passed very slowly from the heated to the cool end it is able to withstand sudden changes of temperature, etc., without fracture.

PRINCE OF WALES, The, in England, a title given to the eldest son of the sovereign and heir apparent to the throne. The title, created and not hereditary, dates from the reign of Edward III. When the principality of Wales came under English domination with the deaths of the native princes Llewellyn in 1282 and David in 1283, Edward I in 1284 is said to have presented his infant son Edward, born at Camarron Castle, to the Welsh people, as a native-born prince. He was not invested with the title, however, until 1301. A statute of the order of the Garter, dated 1805, declares that the Prince of Wales shall, as soon as he receives this title, becomes a knight of the Garter. The arms of the Prince of Wales are the royal arms, with the addition of a label of three points argent, and the distinctive Welsh feature of a plume of three white ostrich feathers, circled by the ancient princely coronet of Wales, bearing the motto badge «Ich Dien» («I serve»).

PRINCE OF WALES ISLAND, the official name of Penang, an island of the Malay Straits Settlement. See PENANG.

PRINCE WILLIAM SOUND, Alaska, an inlet of the Gulf of Alaska, on the south coast, east of the Kenai Peninsula and with Montague Island on the south. It offers an ice-free harbor, the most northerly on the coast, and has spectacularly beautiful scenery. Its glacial phenomena is particularly remarkable, the sound having 11 living glaciers, of which the most striking are the Columbia, Harvard, Yale, Serpentine, Harriman and Surprise. The Columbia is about four miles wide on the sound and reaches in places a height of 300 feet. The rich deposits of copper on the eastern shores and on some of the islands offer splendid possibilities for development. Of the towns, Valdez and Cordova have each about 1,000 population and are coast terminals of railroads running into copper districts in the interior. Smaller towns are Onca, Ellamar and Landloch. Consult Higginson, ‹Alaska›; Greely, ‹Handbook of Alaska› (1909); ‹National Geographic Society Bulletin› (1914).

PRINCEITES, prĭn′sīts. See AGAPEMONE; RELIGIOUS SECTS.

PRINCE'S FEATHER, an annual plant (*polygonum orientale*) of the buckwheat family, with erect spikes of dark-red flowers and leaves inclining to purple. It is a native of India, but has long been cultivated in gardens everywhere.

PRINCE'S ISLAND, or ILHA DO PRINCIPE, ĕl′yä dō prēn′sē-pĕ, a Portuguese island off the coast of West Africa; in the Bight of Biafra; nearly midway between Fernando Po and Saint Thomas islands. It is of volcanic character, rising in the south to 3,000 feet; fertile and well-watered, but of little importance since the extinction of the slave-trade ruined its sugar plantations. Its fertility has gained it the name of the Garden of Africa. Cacao is the only important export. The population is concentrated mainly in São Antonio, a town with a fine harbor on the northeast coast. With the neighboring island of Saint Thomé it constitutes a province under a governor.

PRINCE'S ISLANDS (ancient DEMONESI), a group of nine islets near the east end of the Sea of Marmora, about 10 miles southeast of Constantinople. Prinkipo is the largest of the group. They are a favorite summer resort of the Constantinople Greeks, and in old times were frequently a place of exile for those who were in disfavor at the Byzantine court. There are on the islands a Greek church, seminary, monasteries and a naval college. In 1894 an earthquake caused loss of life and destruction of property. Pop. estimated 10,500.

PRINCE'S METAL, *in metallurgy,* a mixture of copper and zinc in imitation of gold.

PRINCE'S PINE, or PIPSESSEWA, a low North American evergreen health-plant (*Chimaphila umbellata*) of the wintergreen family. From its leaves are made a powder and a fluid extract, used in making a herb-medicine for scrofula, rheumatism, etc. Another species is the spotted wintergreen (*C. maculata*).

PRINCESS. See NOBILITY; PRINCE.

PRINCESS, The, by Alfred Tennyson, published in 1847, reprinted in 1848 and in 1850, was acclaimed as «the herald-melody of the higher education of women,» a theme which Tennyson held to be one of the two great problems of the England of his day. The poem is the expression of his belief in a larger training and a fuller life for woman, based on her «distinctive womanhood,» her power of love. The story of the winning of the Princess Ida by the Prince who invades her college but respects her cause is frankly a «medley,» in which armored knights fight tourneys while gowned ladies lecture on the nebular hypothesis. Prologue and conclusion, set amid a Gothic ruin and a Victorian Chautauqua, strike the «mock-heroic» key-note. But Tennyson lacked the true comic spirit that could fuse his theme, satire and sentiment into entire unity of mood and style. Yet the interest and charm of the parts almost conpensate for the lack of integral beauty. The characters, sketches though they are, embody all shades of opinion on women's education, from Lady Blanche, a true militant, to the old king, a father of «antis.» The Princess herself, the one full portrait, whom Tennyson held one of his noblest women, seems a trifle too heroic in her passion for freedom and too abject in her yielding to love. It is not she but the Prince who speaks the poet's famous verdict on the woman question.

No poetry is more Tennysonian than the blank-verse of 'The Princess,' more filled with his richly-wrought word-harmonies, his memorable nature-pictures painted from the life. Lovelier still are the lyric links, added as an afterthought to ring the changes on the motif of the poem, the love of man and woman for each other and for the child. 'The Princess' lives, less because it declares that «the woman's cause is man's,» than because it contains 'Sweet and low,' 'The splendour falls,' and, most melodious of unrhymed lyrics, 'Tears, idle tears.' Consult Tennyson, Hallam, 'Alfred, Lord Tennyson: a Memoir' (2 vols., 1897); Grierson, H. (in 'Cambridge History of English Literature,' Vol. XIII, ch. 22, and bibliography).

FRANCES W. CUTLER.

PRINCESSE DE CLEVES. 'The Princess of Cleves' by Madame de la Fayette appeared first under the name of 'Segrais' in 1678. It is a novel, but it is in form and content in the sharpest contrast to the novels that had up to that time been in vogue. They had been interminable affairs, in 10 and 12 volumes, made up of the most extraordinary adventures, through which paragons of valor were made to pass before their love-laden sighs might with propriety melt the heart of the paragons of beauty who were the objects of their adoration and they might lead them to the altar. This was a short and simple story, scantily furnishing a thin volume, without heroic or gallant adventure, without paragons of beauty and valor and without wedding bells. It is a drama of conscience. A married woman is the heroine. What fixes our attention and interest is the moral experience of a noble character striving to realize a high ideal of duty in a difficult situation. It is such a victory of wise self-control and steadfast will over impulse and passion as Corneille loved to present in his tragedies. It is essentially a novel of character, in which psychological analysis and penetrating observation of human conduct as it displays itself under familiar conditions take the place of breathless action and thrilling situations. The influence of the «Princess of Cleves» was very great, and it is not too much to say that it marks an important turning point in the history of the novel. The great masters of the early 18th century, like Marivaux in France and Richardson in England, who determined the course the modern novel was to take, developed her method and applied it on a much broader canvas, but not always with more perfect results. There is a translation by Thomas Sergeant Perry (Boston 1891).

ARTHUR G. CANFIELD.

PRINCETON, Ill., city and county-seat of Bureau County, on the Chicago, Burlington and Quincy and the Chicago, Ottawa and Peoria railroads, about 100 miles west by south of Chicago. It was settled in 1830, incorporated in 1838 and in 1884 was chartered as a city Since 1915 it has been governed on the commission plan. It is in an agricultural and coal mining region. Its industries are connected chiefly with farm products and the mining and shipping of coal, and the shipping of livestock. It has a number of well-built business blocks, a township high school, the Maton Public Library, a courthouse, city hall, Federal building and the high school library. The city owns and operates the electric-light plant and the waterworks. Pop. 4,300.

PRINCETON, Ind., city and county-seat of Gibson County, on the Southern and the Chicago and Eastern Illinois railroads, about 27 miles north of Evansville. It was settled in 1804, incorporated as a town in 1814 and chartered as a city in 1884. There is a local traction line operated by a public utility company. Princeton is in an agricultural and coal mining region and is also rich in oil and natural gas. The chief industrial establishments are the Southern Railroad shops, the coal mines, oil wells, lumber mills, flour mills, clock works, handle factory, refrigerating and ice plant and several smaller establishments. There are large lumber and brick yards. The city has several churches; and the educational institutions are a high school, public and parish schools and a Carnegie public library, Civic League Club and a Chamber of Commerce. The banks have a combined capital of $250,000. The government is vested in a mayor, who holds office two years, and a council of six members. Pop. 9,000.

PRINCETON, Ky., city and county-seat of Caldwell County, 140 miles, direct, southwest of Louisville, at a junction of the Illinois Central and Ohio, Louisville and Nashville railroads. It is the seat of the Princeton Collegiate Institute. The repair shops of the Illinois Central Railroad are located here and the city has extensive interests in tobacco. There are flour mills, brickyards, an ice plant and a creamery. Pop. 3,015.

PRINCETON, N. J., borough in Mercer County, on an elevation about three miles from the main line of the Pennsylvania Railroad, with which it is connected by a branch line, 10 miles northeast of Trenton, and 50 miles southwest of New York City. It was settled in 1696, but remained a straggling hamlet for some years. The removal of the College of New Jersey from Newark to Princeton, in 1756, gave the place new life, and except when it was occupied by troops, and as a battleground, it has ever since remained a staid college town. On 27 Aug. 1776, the first State legislature of New Jersey met here. The 31st, the members elected William Livingston as governor of the State. Congress assembled here June 1783, and remained in session until November. The removal of Congress from Philadelphia was occasioned by the threatening attitude of discontented soldiers. While in session here, 31 Oct. 1783, the news arrived of the signing of the treaty of peace with England. Princeton has broad, well-shaded streets, and its location on the ridge gives it a fine view over the surrounding country. The colonial architecture has been preserved to quite an extent. The place is noted as being the seat of Princeton University (q.v.). Other educational institutions are Princeton Theological Seminary (Presbyterian), the Rockefeller Institute for Medical Research, Princeton Preparatory School, Saint Joseph's College, the high school and the libraries. Pop. 5,678. Consult Hageman, 'History of Princeton and Its Institutions' (Philadelphia 1870) and Powell, L. P., 'Historic Towns of the Middle States' (New York 1899).

PRINCETON, W. Va., city and county-seat of Mercer County, 75 miles southeast of Charleston, on the Virginia Railway and near the southern border of the State. It was the scene in 1862 of a skirmish between the United States and Confederate forces, the advantage resting with the Confederates. Pop. 3,027.

PRINCETON, N. J., **Battle of,** in the American Revolution. After the battle of Trenton (q.v.), Washington recrossed the Delaware and on 2 Jan. 1777 occupied Trenton with strong outposts at Bordentown and Crosswicks. General Grant, commanding the British troops at New Brunswick, 30 miles distant, was joined by Lord Cornwallis (q.v.), who was preparing to return to England but had been ordered to resume his command in the Jerseys. The British and Hessians, about 8,000 strong, pressed forward to Trenton, whereupon Washington took position on high ground behind Assanpink Creek. On 2 Jan. 1777 the British cannonaded the American position but deferred the attack until morning, when Cornwallis hoped «to bag the old fox.» On the advice of his generals, however, Washington decided to strike the British in the rear, capture their stores at New Brunswick, attack three British regiments under Col. Charles Mawhood at Princeton and divert the war from the neighborhood of Philadelphia to the mountainous regions of New Jersey. On the night of 2–3 of January, leaving his camp fires burning, Washington sent his stores to Burlington, abandoned his camp, and in the morning fell upon the unsuspecting Mawhood, then marching to join Cornwallis. After the first volley the British charged and the Americans fled but were rallied by Washington and soon put the British to flight. Washington then advanced toward Princeton where he routed another British regiment. The British loss was 150 killed and 230 prisoners, while the Americans lost 30 killed, including Gen. Hugh Mercer. Meanwhile, hearing the cannonade, and fearing for his stores at New Brunswick, Cornwallis pursued Washington toward Morristown, but on crossing the Millstone River, the Americans demolished the bridge at Kingston and Cornwallis abandoned the pursuit, taking up position at New Brunswick while Washington encamped at Morristown. Consult Stryker, W. S., 'Battles of Trenton and Princeton'; Johnston, H. P., 'Campaign of 1776' (p. 293 et seq.); Carrington, H. B., 'Battles of the Revolution' (p. 276 et seq.); Lossing, 'Field-Book of the Revolution (Vol. II); Wilkins, 'Memoirs' (Vol. I, pp. 140–150); Wiley and Rines, 'The United States' (Vol. III, pp. 7–10); biographies of Washington, Greene, Knox and others.

PRINCETON, W. Va., **Engagement at.** In the spring of 1862 General Frémont, commanding a military department that included West Virginia, proposed to move from Monterey on Staunton, thence to the New River near Christianburg, his ultimate destination being Knoxville, Tenn. Gen. J. D. Cox, commanding on the Kanawha, was to co-operate by advancing from Gauley Bridge, in two columns, one by Fayette and Raleigh Court House over Flat Top Mountain to Princeton and «the narrows», of New River, the other by the turnpike to Lewisburg. Cox had four brigades; one was left to hold the lower Kanawha Valley; Col. George Crook was sent forward to Lewisburg; and Cox, with the two brigades of Colonels A. Moor and E. P. Scammon, about 2,000 men each, moved on the Fayette and Princeton route. Giles Court House and «the narrows» of New River were reached 7 May, and on the 16th his two brigades, after leaving a detachment at Princeton, were on the East River, and Crook had reached Lewisburg, on the other side of New River, all prepared to joint Frémont's main column at Christianburg. But «Stonewall» Jackson's appearance in the Shenandoah Valley sadly deranged Frémont's plans, and Cox was told to look out for himself. Meanwhile the Confederate brigades of Generals Humphrey Marshall, Harry Heth and J. S. Williams, all under command of Marshall, had been concentrated to protect the Virginia and Tennessee Railroad, and on the 16th Marshall, leaving Heth to hold the passes of New River, marched with about 2,500 men and three guns by the Wytheville road on Princeton, driving out the small detachment Cox had left there, after a stubborn resistance of six hours, continued until 10 P.M., and capturing the camp, with several tents, horses and other things, including the headquarters correspondence. During the night Cox, with Moor's brigade, marched back from East River, ordering Scammon to follow, and at daylight of the 17th found Marshall withdrawing from the town and back to a wooded range of hills south and west of it. Cox advanced and attacked, and Marshall again fell back a mile, to a strong position covering the Wytheville and Wyoming roads, and waited for Heth to come up. Cox made some demonstrations, but seeing that Marshall held a steep wooded ridge, not easily accessible, and had a large force and some artillery, he waited until Scammon should come up, before making a serious attack. Scammon came up in the evening, closely pursued part way by Heth, and brought information that the Confederates were in great force; and Cox, realizing that his position at Princeton could be turned and his line of communication seized, retreated before daylight next morning to Flat Top Mountain, 25 miles from Princeton, a very strong position, and ordered Crook to halt at Lewisburg. Heth attacked Crook at Lewisburg on the 23d and was badly repulsed. (See LEWISBURG, BATTLE OF). The Union loss at and around Princeton was 23 killed, 69 wounded and 21 missing; the Confederate loss was much less. Consult 'Official Records' (Vol. XII); The Century Company's 'Battles and Leaders of the Civil War' (Vol. II).

E. A. CARMAN.

PRINCETON THEOLOGICAL SEMINARY, a Presbyterian seminary at Princeton, N. J. It was organized in 1812, and for a time the classes were held in the buildings of Princeton College (now Princeton University); in 1815 a tract of land was purchased for the seminary, and a building erected. «The biblical criticism is conservative,» and «the theology taught is that type of Calvinism set forth in the Westminster Confession.» The courses include instruction in Old and New Testament theology, literature and history, homiletics, church history, pastoral theology, systematic theology and Hebrew. The regular course is three years, a fourth year of graduate study is also provided for and arrangement is made for «extra-curriculum» courses at the university. Students who are college graduates are admitted without examination; others must take examination for admission in full standing; students, however, on filing a certificate from the presbytery or ecclesiastical body under whose care they are studying for the ministry may without examination enroll in the classes and receive the certificate for completion of the course, but are not technically considered graduates of the seminary. The degree of bachelor of divinity is conferred on students who have received the degree of bachelor of arts. The buildings include two library buildings, Stuart Hall and three dormitories. In 1917 the institution had 14 instructors, 187 students, 103,000 volumes in its library besides pamphlets, $664,055 invested in grounds and buildings, $3,208,484 in productive funds and $148,692 in total income, and its graduates numbered 6,233. Francis Landey Patton, D.D., LL.D. who was president of Princeton University in 1888–1902, became president and professor of the philosophy of religion at the seminary on retiring from the university and served till 1914, when he resigned and was succeeded by Joseph Ross Stevenson, D.D., LL.D.

PRINCETON UNIVERSITY, located at Princeton, N. J. The first movement toward the establishment of the College of New Jersey was made in 1739 by a committee appointed by the Presbyterian Synod of Philadelphia, but this committee met with little success and the project was laid aside for the time. In 1746 the promoters of the new college, who in the meantime had withdrawn from the Synod of Philadelphia and with others had formed the Synod of New York, again took up the matter and obtained a charter for the new college. In the same year the Log College, which had been conducted by Rev. William Tennent, Sr., near the Forks of Neshaminy, Pa., as a training school for ministerial candidates, was closed by the death of Mr. Tennent, and its leading men joined with the trustees of the new college. A second charter for the College of New Jersey was obtained in 1748. The scope of the college and the powers of the trustees as stated in the two charters were essentially the same, but the second charter was obtained by the original trustees, both because of some doubt as to the validity of the first charter, which had never been recorded verbatim in the records of the secretary of state, and also for the purpose of increasing the number of trustees, making the lay trustees equal in number to the clergymen and giving other religious communions a share in the administration.

The college was opened at Elizabethtown, N. J., in April 1747, with Rev. Jonathan Dickinson as president and was transferred to Newark in the autumn of the same year, where it remained until 1756. In 1752 it had been decided to fix the location permanently at Princeton, and in 1756 the college building (Nassau Hall) was completed and instruction was begun there. The college exercises were interrupted during the Revolution by the presence of both armies, but only one Commencement, that of 1777, was omitted. During the war Nassau Hall was badly damaged, the library scattered and destroyed and the scientific apparatus ruined. In 1783 the Continental Congress sat in Nassau Hall for several months. A law department was established in 1846, but discontinued in 1852 on account of lack of funds. The system of elective studies was introduced in 1870; the John C. Green School of Science was established in 1873; the Graduate School in 1877, and the School of Electrical Engineering in 1889.

In October 1896, on the occasion of the 150th anniversary of the founding of the college, the title of Princeton University was assumed. In 1900 a plan of alumni representation in the board of trustees was adopted, giving the alumni five elected representatives on the board. The other trustees are elected by the board itself and hold office for life.

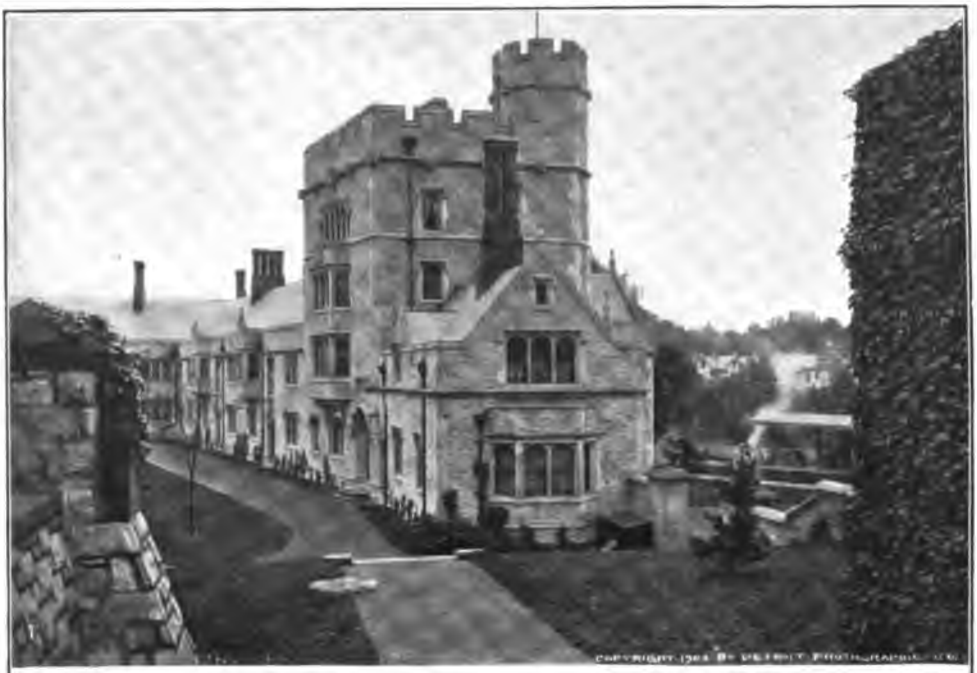
The courses now offered by Princeton University may be classified as undergraduate courses in arts and sciences; graduate courses in arts and sciences; and technical courses.

The plan of undergraduate liberal studies provides for two distinct courses: first, the bachelors of arts course (A.B.), in which Latin is required for entrance and forms a prescribed part of the curriculum of the first year; second, the bachelor of science course (B.S.), in which a modern language may be substituted for Latin at entrance.

The Graduate School offers advanced and research work in arts and sciences, leading to the degrees of master of arts and doctor of philosophy.

The technical courses offered are a four-year undergraduate course in civil engineering; and a two-year graduate course in electrical engineering, leading respectively to the degrees of civil engineer and electrical engineer.

PRINCETON UNIVERSITY



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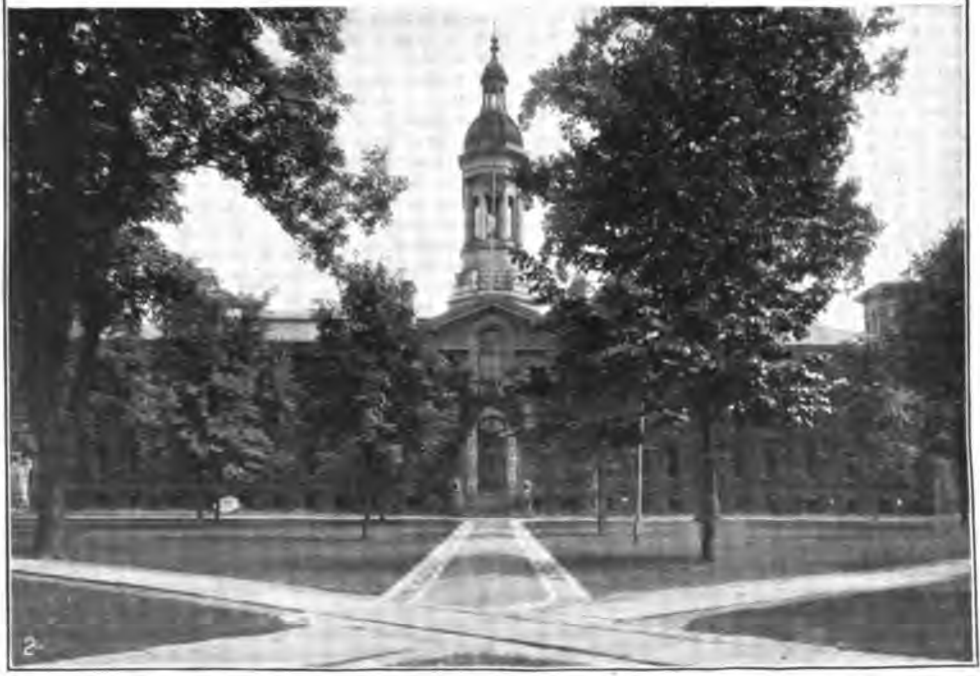


1 Stafford Little Hall

2 Nassau Hall

Admission to the undergraduate courses is entirely by examinations, which are conducted by the College Entrance Examination Board. The subjects required for admission vary in the different courses and while certain subjects are definitely required, there is a considerable margin for choice in the subjects offered by candidates. Distinguishing features of the undergraduate courses are: (1) the planning of the requirements for the bachelors degrees so that the student shall receive a broad general training, preserving as far as possible the ideal of the old American college course; (2) the treatment of the student's preparation and college work as a whole and the requirement for graduation of a specific number of units, part of which must be met before entering the university; (3) the requirement that a student shall have completed before the middle of his college course a certain number of units in language including English, in mathematics, science and in philosophy; (4) the divisional elective system, according to which a student must choose in his junior year at least three courses in a division (philosophy, literature, art or history, politics, economics or mathematics, science), in which his work will thereafter be concentrated. His other two courses are unrestricted. Beginning with sophomore year which has only one required course, the student has a full choice of electives within certain limitations; (5) an arrangement whereby students of high standing may by independent study during the summers qualify for graduation in three years. And (6) the preceptorial method of instruction, by which the lectures are complemented by informal conferences between the professors and small groups of students on the reading connected with a course. The preceptorial groups usually consist of from three to six men, thus emphasizing the personal relation between teacher and student. All members of the faculty engage in preceptorial work.

In the undergraduate department there are 40 university scholarships and about 40 endowed scholarships, ranging in stipends from $100 to $500. The endowment plans of the university include the founding of over 100 scholarships in memory of Princeton men fallen in the service of the country in the recent European War. The university also offers remission of part of the tuition charge to undergraduates of small means and good scholarship, but no student may hold a scholarship and remission of tuition at the same time. In the Graduate School there are the Jacobus Fellowship and 10 Proctor fellowships with a stipend of $1,000 each, and in addition about 35 fellowships paying $600 to $700, of which 16 are wholly or partly endowed. There are also a number of graduate scholarships paying $250 and $100 respectively.

A feature of the Graduate School is the Graduate College of residence, where the graduate students may live amid surroundings which tend to emphasize the proper academic and social life of a community of young scholars. The Graduate College buildings were completed in 1912. In connection with this group of buildings is the Cleveland Memorial Tower, erected in memory of President Grover Cleveland.

The present University Library consists of the Chancellor Green Library, built in 1872–73, and the Pyne Library (1896–97), which are united by a delivery room, 50 by 20 feet. The library collection in 1760, when the first catalogue was printed, consisted of 1,300 volumes. It now numbers about 410,000 volumes besides pamphlets. This includes several special collections and seminary libraries. The Garrett collection of Oriental manuscripts, the Garrett collection of coins, the Hutton collection of death masks and the Meirs collection of Cruikshankiana are also located in the library. There are six departmental libraries: art, astronomy, biology, geology and palæontology, engineering and physics, each selected from the general collection and kept in the Art Museum and the several laboratories. These departmental libraries number over 31,000 volumes. The Princeton Theological Seminary Library of over 100,000 volumes is also open to students of the university.

The university campus contains about 700 acres. Besides Nassau Hall, the library and the Graduate College already mentioned, among the buildings are 16 dormitories, some of them of unusual architectural beauty; Dickinson and McCosh Halls, for classroom work; the Halsted Observatory, the Infirmary, the Marquand Chapel, Alexander Hall; the John C. Green School of Science, used chiefly by the department of civil engineering, the Chemical Laboratory, Palmer Laboratory, for physics and electrical engineering, Guyot Hall, the laboratory of the departments of geology and biology and Madison Hall, containing the university dining halls.

The athletic equipment consists of the Palmer Memorial Stadium, for intercollegiate football, and track; University Field, for baseball; the Gymnasium; Lake Carnegie for rowing; the Brokaw swimming tank; Brokaw, Poe and Goldie fields, providing several baseball diamonds and soccer fields; and 28 tennis courts. Under the direction of the department of hygiene and physical education all freshmen are required to take regular exercise and members of the other classes are encouraged to do so. At least three-fourths of all the undergraduates take part in some form of intercollegiate athletics.

There are no secret societies at Princeton, but there are two literary societies, the Cliosophic and the American Whig, founded prior to the Revolution. Most of the upper classmen are members of eating clubs. All freshmen and sophomores are required to board at the university dining halls.

The productive funds, according to the latest report, amount to $6,565,000. The annual income from all sources averages $839,300. The yearly attendance of students is about 1,600, and the faculty numbers about 200.

PRINCIPAL AND AGENT. See Agent.

PRINCIPE, prēn'thē-pā, Philippines, subprovince of Tayabas, situated on the eastern coast of Central Luzon, bounded on the north by Isabela and on the south by Nueva Ecija; length along the coast, 64 miles; area, 1,216 square miles, with dependent islands, 1,218 square miles. The district is almost entirely mountainous; there are two main ranges, one near the coast, following the coast line, the other parallel with it, with narrow valleys between. Near the towns rice, corn, coffee, cotton, sugar and vegetables are raised, but for home consumption only; there are a few simple mechanical industries, also for domestic use. The chief industry along the coast is fishing and the fish are exported to the provinces to the south. Game is abundant in the mountains and many of the inhabitants are engaged in hunting. The inhabitants of the western slope of the peninsula of Tayabas use the Tagalog dialect; those in the eastern, the Bicoe. In 1902 the former district of Principe was annexed to the province of Tayabas. Pop. about 14,470.

PRINDLE, prin'd'l, **Cyrus,** American Methodist clergyman: b. Canaan, Conn., 11 April 1800; d. Cleveland, Ohio, 1 Dec. 1885. He was licensed to preach in 1821 and until his retirement in 1877 occupied various Methodist pulpits in New York, Vermont, Massachusetts and Ohio. Opposed to the attitude of the Methodist Episcopal Church with regard to slavery, he became in 1843 the chief leader in the movement that resulted in the founding of the Wesleyan Methodist Church in America. He was an abolitionist from principle and when he had seen the work to which he and his followers were devoted accomplished in the emancipation of the slaves, he returned to the Methodist Episcopal Church.

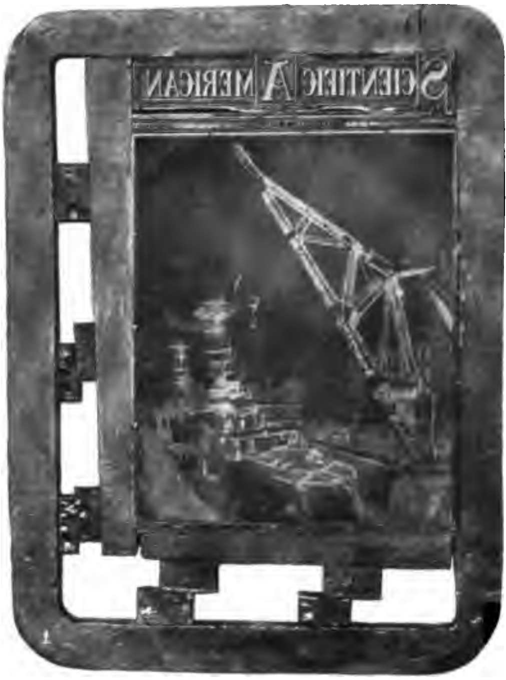
PRINGLE, prin'g'l, **Thomas,** Scottish poet: b. Blaiklaw, Roxburghshire, 5 Jan. 1789; d. London, 5 Dec. 1834. He was educated at Edinburgh University and in 1811 became a copyist in the registry office, Edinburgh. He began writing clever satire and attracted the notice of Sir Walter Scott, who in 1817 gave him his notes for an article on the gypsies, which Pringle contributed to the *Edinburgh Magazine,* started by himself and Cleghorn, and known after a rupture with the publisher as *Blackwood's.* In 1820, with 24 others, he emigrated to South Africa, settling finally at Cape Town, where for three years he was librarian of the government library. Pringle worked hard to secure financial support for the colony by pamphleteering and started The South African *Journal* and The South African *Commercial Advertiser.* These were suppressed by Lord Charles Somerset, the governor of the colony, because of their liberal tendencies and Pringle was reduced to poverty. In 1826 he returned to London and in 1827 became secretary of the Anti-Slavery Society. After seeing the triumph of his humanitarian endeavors in the abolition of slavery by England, in 1834, he died on the eve of returning to South Africa. His earlier poems were collected by him as 'Ephemerides' (1828); and the best of these, dealing with South Africa, were reprinted in 'African Sketches,' which included also the 'Narrative' of a residence in South Africa. These productions were characterized by vivid description and tender feeling. He is best known by his poem, 'Afar in the Desert I Love to Ride,' reprinted in the volume of 'African Sketches' (1834). Pringle's 'Poetical Works' with a life were edited by Leitch Ritchie in 1839.

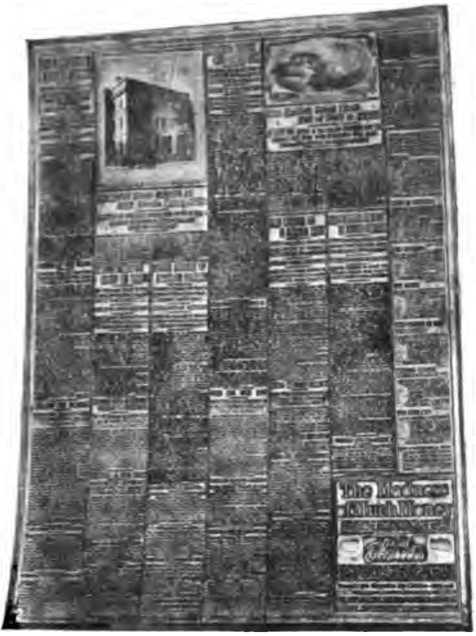
PRINSEP, Valentine Cameron, English artist and author: b. Calcutta, India, 14 Feb. 1838; d. London, 11 Nov. 1904. He was educated for the government civil service, but displayed so much artistic talent that he became a pupil of George Frederick Watts. Oriental, classical, romantic and sporting subjects appealed strongly to him. His first notable exhibition success was gained by his 'The Linen Gatherers' (1876). He was elected R.A. in 1894, and subsequently became professor of painting to the Royal Academy. In 1876 he went to India to paint 'The Declaration of the Queen as Empress,' which was exhibited in 1880. His other paintings include 'Bianca Capella,' his first Academy picture (1862); 'The Fisherman and the Jinn'; 'At the First Touch of Winter'; 'A Minuet'; and 'A Bientot.' Of his two plays, 'Cousin Dick' appeared at the Court Theatre and 'M. LeDuc' at Saint James'. He was also author of 'Imperial India'; 'An Artist's Journal'; 'Virginie'; and 'Abibal, the Tsourian.'

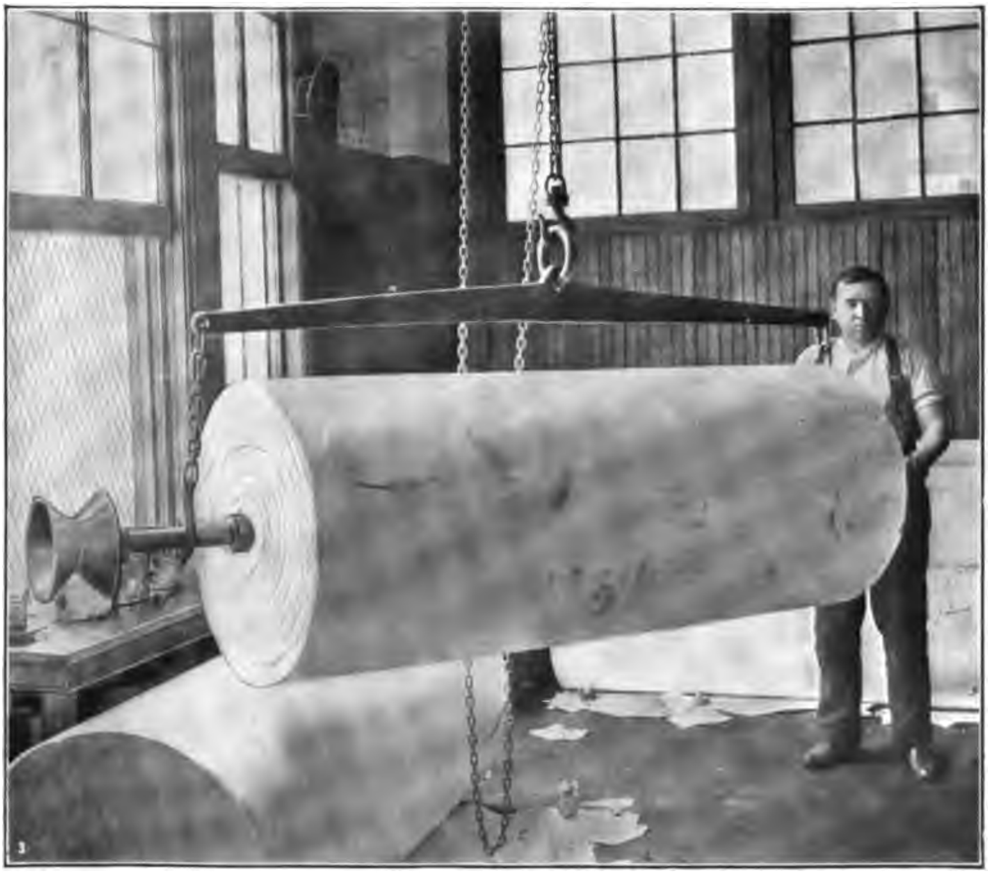
PRINTING, the art of producing impressions from characters or figures on paper or other substance. Printing from movable types is of comparatively modern origin, it being less than 500 years since the first book was issued from the press; yet the principles on which it was ultimately developed existed among the ancient Assyrian nations. Printing from blocks and clay tablets was practised in China as early as 50 B.C. The great discovery was that of forming every letter or character of the alphabet separately, so as to be capable of rearrangement and forming in succession the words, lines and pages of a work, thereby avoiding the labor of cutting new blocks for every page.

The city of Haarlem in Holland claims that Laurens Janszoon Coster there invented the art of printing in 1423, making use of movable types of wood and afterward of lead and tin; but no printed works of his can be identified. The claims of Johannes Gutenberg (q.v.) to this invention are now generally recognized. He without question was occupied in various experimental researches of a secret nature in Strassburg, and possessed in 1438 printing materials, a press, and as it appears movable types. No book, however, was brought out by their use until after Gutenberg had returned (which was about 1450) to his native city of Mainz. Here he associated himself with a wealthy citizen, Johann Faust, who, on learning the secrets of the art, entered into partnership with Gutenberg, and agreed to furnish funds for developing the process. They employed to assist them Peter Schöffer, a scribe whose previous occupation had been the copying of books, and who appears to have been a man of taste and genius, and well fitted to bring a new process of this sort favorably before the public. He has the credit of substituting metallic types cast in plaster molds in the place of those which Gutenberg had previously made by carving pieces of wood and metal, and of still further perfecting the art by the invention of punches in hard metal, by the use of which sharpness of outline could be given to the matrices in which the types were cast, and perfect uniformity be retained in the type by continuing to use the same punches for producing as many matrices as might be required. The inventors succeeded in printing a considerable number of books, the first of which known to have been printed with movable types

PRINTING







1 A page form ready for electrotyping 2 A stereotype plate of a newspaper page
3 A roll of news paper ready for printing

were three editions of Donatus. Printing presses were in operation at Subiaco near Rome in 1465, and the types employed were more like those now called Roman than like the Gothic forms of the Germans, which with the characters imitating handwriting had up to this time alone been used. In 1469 printing was introduced into Milan and Venice; and the productions of the presses of John de Spira and Christopher Valdarfar of the latter city attained great fame for their perfection and beauty. Printing was introduced into Paris in 1470 and into London in 1474. (See Caxton, William). Before the year 1500, it is stated, printing presses had been set up in 220 places in Europe, and a multitude of editions of the classical writers in their appropriate Greek and Latin characters were given to the world. A Greek grammar wholly in Greek types was printed in Milan in 1476. A Hebrew Bible was printed at Soncino in the duchy of Milan in 1488. Italic type was invented about the year 1500 by Aldus Manutius of Venice. From the 17th to the 19th century a great variety of ornamental type came into use, the styles differing from each other in the shapes of the letters, in the heaviness or lightness of the lines and in the shading. Great ingenuity has been exercised in multiplying these varieties in so limited a field. The largest size of type for books was formerly called great primer, and is seen in the largest old Bibles; it is now seldom used. The other old names now going into disuse are English, pica, small pica, etc. See table below. The term pica, however, is retained, being one-sixth of an inch, a convenient standard unit for type measurement.

Great Primer, English, Pica,
Small Pica, Long Primer, Bourgeois,
Brevier, Minion, Nonpareil, Agate, Pearl, Diamond, Brilliant

Late in the 19th century the «point» system was adopted generally by printers. In this new arrangement one inch equals 72 points and consequently 12-point would make six lines to the inch. The principal types are designated as follows:

Nonpareil	6 point
Minion	7 "
Brevier	8 "
Bourgeois	9 "
Long primer	10 "
Small pica	11 "
Pica	12 "

For handbills or posters special types are employed of extra large sizes and named in multiples of pica, as 20-line pica. From about eight-line up they are commonly made of hard wood. A complete assortment of one size is called a font or fount, and the «sorts» that make up an ordinary font of Roman type are as follows: Three complete alphabets in capitals, small capitals and small or «lower case» letters, making 78 characters; the double letters ff, fi, fl, ffi, ffl (each cast in a single piece on account of the kern or bend of the f not permitting it to stand separately against another f, an i or an l), 5; the diphthongs Æ, Œ, Æ, Œ, æ, œ, 6; figures, 10; marks of punctuation, 6; the apostrophe, hyphen, parenthesis and bracket, 4; four sizes of dashes and braces in five pieces, 9; the characters &, &, $, £, ☞, 5; and the references *, †, ‡, §, ||, ¶, 6; total characters, 129. Besides these, there are required for filling the blanks between words at the end of lines, etc., four sizes of spaces and four of quadrats (the former and the smallest of the latter being subdivisions of the em [m] or square of the size of the type, one equal to it and the other two multiples of it), making altogether 137 sorts.

The early printers cast their own type; made their own ink-balls, or ink-rollers; instructed some local blacksmith to make the iron frames or chases in which the types are confined for printing; and either made or designed the wooden cases and stands that held their type. With the advent of the iron hand press and the cylinder press or machine, press-building became a separate business. (See Printing Presses). Early in the 19th century the making of type or type founding was separated from the printing office. (See Type). Paper-folding machines began to be manufactured about 1860, and as these developed, and other conveniences were discovered, the business of binding became separated. (See Bookbinding). About the same time experimental type-composing machines were built, culminating in the linotype or slug-casting machine. (See Composing Machines). Stereotyping, electrotyping, photo-engraving, lithography, all have come from the printery and developed into separate arts or industries, and to gain a broad view of modern printing all these subjects should be consulted by the students. At the present time a very large part of the composition work on books and newspapers is performed by machine instead of by hand. One of the great troubles with hand composition is the time necessary for distributing the so-called dead matter after it has served its purpose on the press or in giving the impression for an electrotype. Make-up is the term employed to designate the taking of composed type from the galley and building or making it into a page of the prescribed size, adding titles and folio or page numbers, etc. Proofs are taken from type in galley and also in page form. These are read for errors and corrections are made before going to press. The form or number of pages placed on the press at one time varies from two to 128, according to the size of the type page and the size of the press. Imposition is the placing of the pages on the press in such a manner that when the printed sheet is folded the pages will follow one another in consecutive order. A letter or number called the signature is placed at the foot of the first page of each section and serves as guide to the binder in assembling or gathering the sheets. Stereotyping is the casting of a page in one piece. Its object is to save the wear on new type-faces and also to permit the release of the type for other work. Stereotyping is now performed by electrotyping and by the papier maché process. In the former the type page is impressed on wax, which is then sprinkled with carbon and iron filings, after which it is immersed in a bath of sulphate of copper through which an electric current is passed. Thereupon a copper coating is deposited on the wax filling out the convolutions of the type. After sufficient strength of copper is so deposited the coat is backed up with softer metal, is taken out, trimmed and beveled, and if necessary is made type-high by affixing to a block of hardwood. Papier maché work is the favorite with newspapers. The autoplate machine is now in general use. Its operation is entirely automatic.

Printing rollers consist of a mixture of glue, glycerine, glucose and sugar. The formula of mixture is varied to suit the speed of the machine and the temperature of the pressroom. In summer it is a frequent happening in a pressroom to have one or more rollers melt under high speed.

Previous to 1865, printing was largely a handicraft. It is true that power presses had come into use for daily newspapers, and also that in some of the printing offices the mass of printing was done on presses operated by man-power, either with a hand crank or lever, or by a treadle for the foot. The type was set wholly by hand. The few pictures introduced were either cut laboriously in wood (see Wood Engraving), or they were drawn on transfer paper, and printed lithographically, and these litho-presses were also run mostly by hand. In the period of about 1875 to 1895 the methods of printing underwent an almost complete change, so that modern printing may really be classed as a new art, or a series of developed branches of industry all working to a common end, the attractive and cheap reproduction of reading matter and illustrations. Printing is now mainly the product of machinery, of a great variety of types, intelligently guided by specialists, few of whom are all-round printers, knowing the art in detail. The typecasting and typesetting or linotyping is almost wholly machine work; the presses all run by power, and are mostly fed from a roll of paper or supplied with sheets by automatic feeding-machines. Many presses deliver their product folded; if not folded it usually goes to a folder, and may be also ruled, punched, embossed, numbered or wire-stitched by machinery. The pictures are drawn by professional artists, photo-engraved, and may then be duplicated by electrotyping, and placed with type in forms for printing. Color printing has advanced, both from the lithographic and typographic side, until the most beautiful and artistic reproductions of paintings are sold with cheap periodicals or given away to advertise goods.

When the term printing is used without qualification, typographic printing from relief plates is understood; but there are many other processes properly included in the broad term printing. The most common of these is lithography, which was originally done from a flat porous stone, but is now executed chiefly from aluminum and zinc plates, which are available for rotary presses, and which have vastly increased speeds. Wallpaper printing is also a different art. The typewriter really prints, though we use the word writing for its accomplishment. The neostyle which reproduces typewriting effects, is really a printing machine, and so are a number of other duplicators on the market, as the mimeograph, multigraph, etc.

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Charles H. Cochrane,
Author of ‘Modern Industrial Progress.’

PRINTING PRESSES. The first printing presses were a development of the cheese or cider press common in all large mediæval households, and needed little change to adapt them to the uses of typography.

Gutenberg's press, upon which he printed his ‘Bible’ of 36 lines (1450?), his ‘Bible’ of 42 lines (1455?), and the ‘Letters of Indulgence’ of 1454, 1455, 1461, consisted of two upright timbers with connecting crosspieces at top and bottom, and with two intermediate cross timbers. The lower one was the support of the form of type. Through the upper passed a large wooden screw, the lower end of which rested on the centre of a wooden platen. After the form of type was fastened to its bed it was inked by hand inking-balls made of wool covered with soft leather. The sheet of paper, previously dampened, was then laid carefully upon the type, and the bed pushed to its place. A wooden lever was thrust into its socket and the platen screwed down, held for a moment and then raised. The bed was drawn out and the printed sheet removed and hung up to dry. For 150 years this simple but effective form of the printing press continued in use, and the books thus printed by Faust and Schöffer at Mainz, Jenson and the Aldi at Venice, Caxton at Westminster, Plantin at Antwerp, the Elzevirs at Leyden and at Amsterdam, and Bade and the Estiennes at Paris have brought their makers the highest fame.

First Improvements.— The first recorded improvements were those of William Janson Blaeuw, of Amsterdam, about 1620. He passed the spindle of the screw through a wooden block, which was guided in the wooden frame, and from it hung the platen. He also invented a device for rolling the bed in and out under the platen, and improved the hand lever for turning the screw. This press was widely used on the Continent, and in England and America, and on such a one Benjamin Franklin worked in London in 1725. One of these, that from the Watt printing house, is now preserved in the Patent Office in Washington. For nearly two centuries this sufficed for books of small editions and for the little-circulated small newspapers and gazettes of the 17th and 18th centuries. The Earl of Stanhope in 1798 made a press with a cast iron frame and greater leverage that had some use in England. George Clymer, of Philadelphia, in 1816 substituted a combination of levers for the screws, and called his invention the Columbian press. He carried it to England and there in 1822 Peter Smith devised a toggle-joint, simple and effective, that replaced the screw and levers.

The final development of the hand press came in 1827, when Samuel Rust, of New York, perfected the Washington press. The iron frame was lightened and strengthened, the toggle motion was improved and a screw top regulated the pressure. With this improved hand press came the substitution of composition inking rollers for the leather covered ink-balls previously employed. The bed was made to slide in and out on a track by turning a crank connected with two endless bands. A bent lever working in a toggle-joint forced the platen down and coiled springs raised it. To the end of the bed was attached the tympan, a wooden or steel frame over which a cloth was tightly stretched and carrying the blanket to modify the force of the impression. When the bed was run out this was raised to an obtuse angle. The paper was laid upon this and carefully fitted to adjusting pins; the frisket, a thin frame holding a sheet of paper cut to the size of the form, was folded over the paper to protect it, to steady it and to raise the paper from the type after the impression. This press has been improved in construction, but in principle and form substantially the same press is widely used to-day in the United States as a proof press and for the special work for which it is fitted. Its capacity is about 250 sheets an hour printed on one side. Alike in principle and construction, though differing in detail of depressing and raising the platen, is the Albion hand press as widely used in Great Britain.

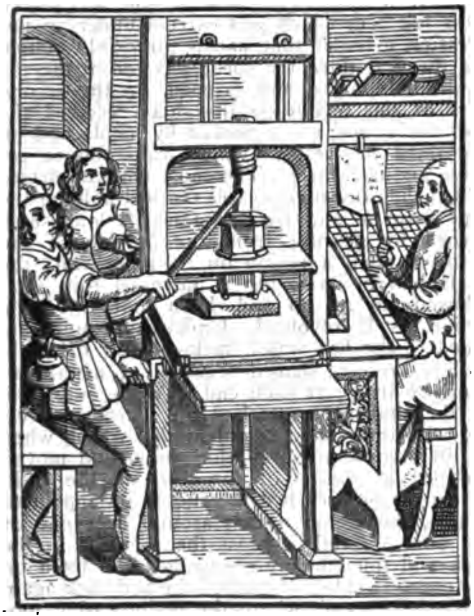


FIG. 1.—The Gutenberg Press.

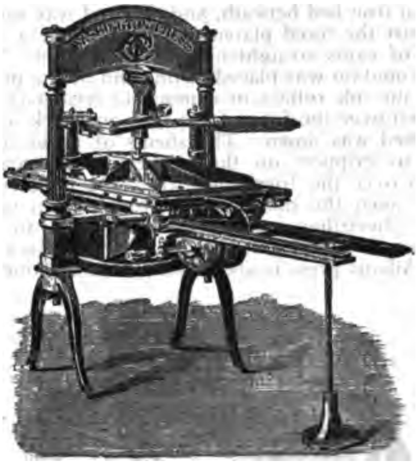


FIG. 2.—Washington Hand Press.

The operation of the hand press when type, press, ink and paper had been prepared necessitated these 11 processes: The form was inked by hand; the paper was fitted to its place on the tympan; the frisket was folded over it to hold it; the tympan was folded down over the form; the bed was run under the platen by turning the crank; the platen was forced down by the workman's power applied to the lever; released, it was raised up by the springs; the bed was rolled out by a reverse motion of the crank; the tympan was raised; the frisket opened, and the printed sheet removed. Modern invention has sought to reduce all these to a single automatic process operated by mechanical power. Necessity divided the course of invention into three lines; the small job press and the large book and newspaper press soon widely diverging in type and construction to secure fine printing in one and the greatest speed in the other.

Bed-and-Platen Presses.—The development of the bed-and-platen power press for fine book work and illustrations reached its highest state in the Adams press, invented and patented by Isaac Adams, of Boston, in 1830 and 1836, and improved in many ways by R. Hoe and Company since that firm acquired his business and patents in 1858. Over 1,000 have been manufactured, and a few were reported to be yet in operation in Boston in 1918. Adams, after a few experiments with a timber frame, built his presses of iron and fixed the platen immovably in the frame. The form was placed on an iron bed beneath, and this bed was raised against the fixed platen and lowered by a system of cams straightening a toggle-joint. The ink fountain was placed at one end of the press, and the ink rollers in a movable frisket-frame passed over the face of the type and back while the bed was down. The sheets of paper were fed to grippers on the frisket which carried them over the form, and after the impression was taken the sheets passed forward on tapes to a sheet-flier, which delivered them to the fly-board. The speed of the larger sizes of the Adams press is about 600 sheets an hour.

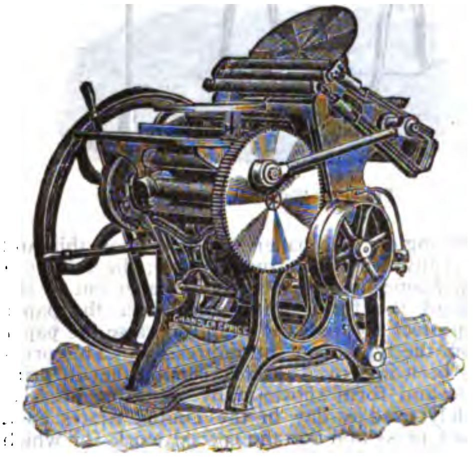


Fig. 3.—Gordon Jobber.

The most successful press designed for small job work substituted for the hand lever and crank a rotary power wheel which could be driven by a treadle by the foot of the operator, or by belt and shafting. The bed was set in a perpendicular frame, and the form was clamped to it. To the bed frame near the bottom was jointed the frame that held the platen. This opened to an angle of about 45 degrees. A crank rod fastened to the wheel brought the platen up to the type form and back at every revolution. On the platen by adjustable pins or quads the position of the paper was exactly fixed. Two thin steel rods automatically folded over the margin of the paper as the platen rose. Above the bed of the press, and at a slight angle, was set a steel inking-disc, about the size of the bed, that slowly revolved, while at every revolution of the driving wheel a pair of ink rollers descended from the inking-disc over the form as the platen fell away, and back to the inking-disc as the platen rose to the dorm again. This automatic inking was even and uniform. This press prints cards, letter-heads, hand-bills and the like. The labor needed is that of a boy or girl to feed and take off the sheets one by one. Many varieties are made, with varying excellence of detail. The Gordon press here illustrated is typical and has been widely used. The capacity is about 1,000 sheets an hour. The Gordon press was followed by a host of imitators. The first real improvement was the use of a cylinder instead of a disc for ink distribution, which came in the Globe machine. This idea was more fully developed in Gally's universal press, and later in Thompson's Colt's armory press, which is also characterized by great strength and rigidity. The Gordon disc type of press was highly developed by Golding of Boston, in a scientifically constructed and rapid machine. The old-style Gordon was reduced in cost of manufacture and has been made in enormous quantities by Chandler and Price, and sold all over the globe.

Cylinder Presses.— The basic principle of the cylinder press — a flat type form passed under an impression cylinder — is as old as Gutenburg's time, when from crude machines of this type copper-plate engravings were struck off; but no practical development of it was made until the beginning of the 19th century. So many patents have been issued since then for various devices to secure excellence or economy of operation that it is possible to note only the most striking and most successful. The first printer to work out a practical cylinder press was Frederick König, a Saxon by birth, who removed to England in 1806. He associated with him James Bensley, a London printer, and a machinist, a fellow-countryman, Andrew Bauer. The product of their labors was a press which they put in operation in London in 1812. The form of type was placed on a flat bed, which was carried under an impression cylinder that had a three-fold action. On the first third the sheet was fed at the top upon the tympan and gripped, on the second part of the revolution the sheet received the impression and was removed by hand; and on the third the empty tympan came up to receive another sheet. The most efficient device which they invented to roll the bed holding the type form to and fro was this: A long shaft turned by gearing from the outside of the frame carried a pinion on its inner end; the shaft had in its length a universal joint that allowed for an up and down motion of the pinion as it revolved. Underneath and fastened to the bed was a rack, or row of teeth, with a crescent-shaped segment of metal and pins, or studs, at each end. To the outer end of the shaft was attached the wheel connecting with impression cylinder; this wheel, when set in motion, revolved the pinion and moved the bed by means of the teeth in the rack. When the bed reached the end of its appointed course, the pinion turned around over one of the pins or studs against the segment in the rack and immediately re-engaged the teeth on the opposite side and carried the bed back again to the other end, where the reciprocating motion was repeated. König followed this in 1814 by a continuously revolving cylinder, which was slightly reduced in diameter along that part of the periphery not used for the impression so as to allow the bed to return under it freely after the impression. He made also a two-cylinder press of this pattern, and two of these two-cylinder presses were set up in the London *Times* office in that year. Their capacity was 800 impressions an hour. This same year he devised a two-cylinder press — the first perfecting press — by which a sheet was printed on both sides at one continuous operation. The forms were placed one at each end, and the sheet after being printed on one side under one cylinder was by tapes carried over a registering roller to the second cylinder for printing on the reverse side. This machine Applegarth and Cowper, by improvement, made very efficient. Every year showed patents on improvements, but the next of great value was that of Napier in 1828 and 1830. He discarded the tapes for the conveyance of the sheets and substituted «grippers» or «fingers» to clasp the sheets to the cylinder for the impression, and for delivering them after printing. He also made the impression cylinders of small size to make two or more revolutions to each sheet printed, and devised the toggle for raising the cylinder to allow the form to run back without touching.

Kōenig and Bauer went to Germany where they later perfected a machine having a bed that rested on and was reciprocated by a four-wheeled truck and crank. They and their successors were the principal makers of printing presses in Germany for 80 years.

The pioneers in introducing cylinder models into the United States were R. Hoe and Company, who had been for some time manufacturing bed-and-platen presses. Robert Hoe sent Sereno Newton (later to be a partner in the house) to England in 1832 to study the new inventions and devise improvements. The Hoe single small cylinder, double small cylinder and large cylinder perfecting press were designed and built, and with added improvements are being manufactured by them to-day. Hoe and Company patented mechanism to drive the bed in 1847. Two racks facing each other on different planes and separated by the diameter of the driving wheel were attached to a hanger fastened on the lower side of the bed. The driving wheel was on a horizontal shaft and moveable sideways, so as to engage first one then the other, of the racks. A roller at either end entering a recess in a disc on the driving shaft in a half revolution brought the bed to a stop and started it in the opposite direction. This was a new principle; a crank action operating directly upon the bed from a shaft having a fixed centre.

As the demand for printing presses grew other makes came into the field. Andrew Campbell designed, perfected and built, about 1865, a single cylinder newspaper and poster press, which became known as the Campbell country press, and which secured the widest sale of any press of that character in its time. By means of a very large gear and reversal mechanism keyed solidly on one end of a drum cylinder, he locked together the bed and cylinder so that register was perfect. The rollers and other mechanism were extremely simple, and he was thus able to sell the presses at a low price. An improved form of this press, styled the complete press, was employed by the early color printers, as McLaughlin Brothers, of New York. Another great success of the Campbell Company was their book and job press, which enjoyed a large sale from 1875 to 1890. This had a small cylinder, called a two-revolution, because it revolved once while the bed was making the return stroke. It employed improved features of ink distribution and sheet delivery. A. B. Taylor and Company were among the early makers of cylinder and double cylinder presses in New York, closely following the lines of the Hoe machines. Cottrell and Babcock began building cylinder presses about 1870, their most notable early production being the stop cylinder, which was popular for a dozen years. Because the cylinder came to a dead stop in taking the sheet, a perfect register was secured, and the other details of the machine being well worked out, it came into use by the best printers. The Hoes also built a stop cylinder to meet the competition. In time Cottrell and Babcock separated, and Babcock brought out the Optimus machine, which was one of the first to deliver its sheet without chance of smutting, printed side up. C. Potter, Jr., also built many cylinder presses, of rather light construction, which sold mostly to country newspaper and job offices. Whitlock followed with a very light and inexpensive cylinder machine, utilizing the Henry bed motion. Walter Scott, who learned printing press building with the Hoes, was one of the most fertile inventors of printing machinery, and established press works in Plainfield, N. J., about 1875. He took out more patents than any other inventor in this field, and developed a long line of useful machinery. About 1880 the half-tone illustration had made such headway, and the demand for superior printing became so imperative, that the dry paper printing on a hard surface came into universal use, and the cylinder presses of the day were all too weak to meet the demands made upon them. All went to building heavier machines, but the Huber and Miehle press builders were among the first to recognize this need, and secured most of the market for fine printing. Automatic paper-feeding machinery has increased the demand for this class of presses. The Miehle, being the faster press of the two, forged ahead, and finally absorbed the Huber Company. It has been widely sold all over the world. The Hoes virtually abandoned the two-revolution fine jobbing press field, but Babcock, Scott, Cottrell and Whitlock built heavier, and remained in the market. Potter quit, and later Campbell, while the Cottrells gradually went into a different class of machinery.

Automatic Presses.— While the above described development of cylinder presses was going on, the small platen press was not forgotten by inventors, who improved upon these machines, and brought out a new class, that are properly styled automatic machines, because they do not require hand feeding of the paper, sheet by sheet. Kidder, of Boston, was one of the first to adapt the reciprocating platen press to use paper fed in from an endless roll, and cut off into sheets after printing. About the same time Meisel of Boston began building special machines, roll-fed, and automatic in operation. These machines were confined to a limited class of work and printed from flat beds. Harris brought out a press in which the type-form was replaced by a curved electrotype plate, mounted on a cylinder, and this not only worked automatically but permitted high speed. This was so successful that a whole line of automatic presses has been brought out by the Harris

Company, which has sold them all over the world. Wood and Nathan improved the old type of Gordon jobber by adding a paper feeding and delivery device, which has become known as the Standard press. Kelly built a small cylinder, self-feeding, automatic press, which is sold by the American Type Founders' Company, and is largely used. The Autopress, Osterlind, New Era and Stokes and Smith presses are others which have successfully entered this field.

Offset Presses.— Late in the 19th century a New Jerseyman named Rubel conceived an offset press, in which the printing was first done on a rubber cylinder, and this rubber cylinder rotated in contact with a printing cylinder, so that a continuous sheet of paper could be run and printed between the cylinders. The idea was developed and the first commercial machines employed by A. H. Kellogg and Company of New York. This machine brought lithographic principles into the field of the typographic printer, and several concerns built them, among the most successful being the Harris Company. They are occupying a wider and wider field, because they permit beautiful artistic illustrations to be executed on a cheap, coarse-finish class of paper. The machines offer special convenience for combining text with illustrations, and are in increasing demand for the printing of illustrated catalogues.

Newspaper Presses.—The demand for faster presses of greater capacity grew enormously with the years of the 19th century, and invention kept pace. The first step forward was the Hoe type-revolving machine, which was put at work in the Philadelphia *Public Ledger* office in 1846. They had put into effect the basic idea of fastening the type to the main cylinder, while smaller cylinders carried the sheets of paper to receive the impression. There was designed an apparatus for fastening the columns of type in a form on a large central cylinder in a horizontal position, each page in its own cast iron bed. «V»-shaped column rules tapering to the base, with a special arrangement for locking up the forms, held the type in place with the surface forming a truc circle. An automatic inking apparatus carried the main ink-well beneath the cylinder, with distributing rollers between the impression cylinders. This first machine was built with four impression cylinders touching the type cylinder so that two were on each side and one as far above the other as possible. The framework of the machine bore four feed tables. At each a boy fed the sheets of paper to the automatic grippers, operated by cams, on the impression cylinders, which carried them around against the revolving forms of the central type cylinder. The printed sheet was conducted out by tapes under the feed board, and the patented sheet-flier, with its long wooden fingers fastened to the shaft and operated likewise by cam and springs, piled them upon the delivery tables. Upon this machine, with 2,000 revolutions an hour, 8,000 sheets were struck off printed on one side. The capacity of the machine was found to be greatly in excess of this, and the number of impression cylinders and accessories was increased to 10, giving the machine a product of 20,000 sheets an hour. Though this machine was cumbersome, and at times threw out type rather liberally, it met a need and the impetus given to the newspaper business was tremendous. Circulations that had been limited to the capacity of the old bed-and-cylinder press were rapidly increased twenty-fold. Many new papers were started. This press maintained its supremacy for 20 years and 175 were built. In 1848 the first sent abroad was set up in the office of *La Patrie* in Paris. Marinoni afterward built similar presses in Paris. The next great step was when there was perfected the process of making curved stereotype plates by the use of flexible paper matrices. A simple adaptation of the bed of the type-revolving machine provided for the clamping of stereotype plates on the cylinders in place of the type forms. The forms could now be duplicated. The large papers such as the New York *Herald*, the London *Daily Telegraph* and the London *Standard* each kept five presses in constant operation as circulation increased.

Web Presses.— There remained yet another step before the increasing requirements of speed could be met. It was taken when William Bullock, an American, of Philadelphia, invented in 1865 the first printing press to print from a continuous web or roll of paper. Thirty years before, Sir Rowland Hill had suggested the possibilities of such a machine based on those that printed cotton cloth from engraved cylinders. But no practical working out of the problem in its details was offered. The Bullock press consisted of two plate cylinders and two impression cylinders, the second of which was made very large to lessen the offset from the first printed side of the paper. The stereotype plates were short of filling the whole circumference of the form cylinders, because the sheets were cut before printing by knives set in the cylinders. This was the radical fault of the press. The sheets were then carried through the press by tapes and fingers and delivered by a series of automatic metal nippers on endless leather belts, placed at such a distance apart as to grasp each sheet successively as it came from the last printing cylinders. The Bullock press was perfected and came into considerable use. The New York *Sun* was the first newspaper to make use of them, and the New York *Herald* soon followed.

In 1868 the London *Times* had gone so far with its own experiments in constructing a rotary perfecting press that it set up the «Walter» press in its office. This had a capacity of 12,000 sheets an hour. It was similar in construction to the Bullock press, except that the cylinders were of uniform size and placed one above the other. The sheets, however, were severed after printing, brought up by tapes and carried to a sheet-flier, which moved back and forth and «flirted» the sheets alternately to boys on either side. This press was equipped with dampening cylinders containing sponges filled with water, and required a very strong and expensive paper. This press was also adopted by the London *Daily News* and the New York *Times*, but has now entirely gone out of use.

To satisfy the demands of small daily papers throughout the country for speed and economy the Duplex press appeared late in the 19th century. It is a flat-bed web-perfecting press and prints directly from the type form with a capacity of from 5,000 to 6,000 per hour of either 4-

6-, 8-, 10- or 12-page papers. The flat-beds are stationary and the cylinders reciprocate over them. By an ingenious method of handling the web of paper, it is taken from the roll, led to the cylinders, printed on both sides and delivered to the folder. It has been brought to a high degree of perfection.

Rotary Perfecting Presses.— About 1875 the modern rapid rotary perfecting newspaper press was born. Numerous inventors were trying to accomplish the feat of feeding from a continuous roll of paper, printing on both sides at one operation, and delivering the product folded and cut as a complete newspaper. They had to overcome the difficulty of offset, that is, the smutting of the second side from wet ink if printed on at once. They had to secure better and more uniform paper than then ordinarily supplied. They had to cut the roll to separate the sheets while the roll was traveling at a rapid rate. These problems were solved more completely by Andrew Campbell than by any other one man, though the credit of the invention has not been usually accorded to him. He built and operated a press in Jersey City which was the first really satisfactory perfecting newspaper press, but through misunderstandings and disagreement with his financial backers he refused to sign the necessary patent papers, or to protect his invention in any way, and allowed it to become public property. In the meantime the Hoes had worked on the problem, and Stephen D. Tucker had patented a rotary collecting cylinder that was a very useful adjunct. The Hoes were, therefore, able to put together all this knowledge and produce a commercial perfecting press, and by continuing to absorb inventions they have become the leading manufacturers in the world of rapid newspaper presses.

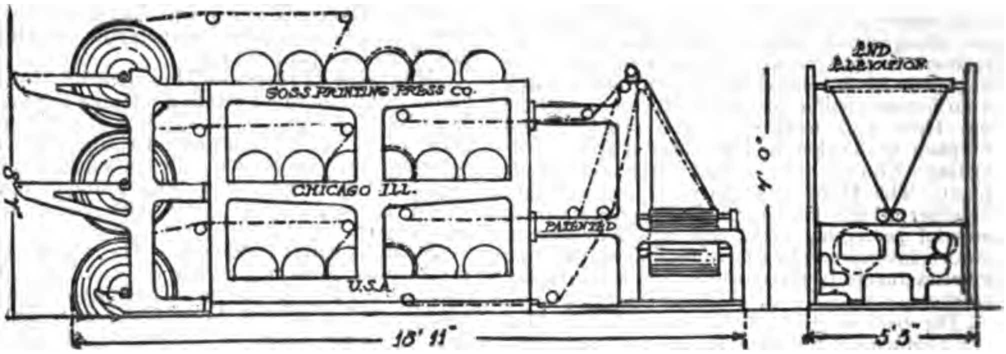
The first machine of this type that R. Hoe and Company built went to London to *Lloyd's Weekly*, and the first to be set up in the United States was used in the office of the New York *Tribune*. The limit of capacity depended on the ability of the web paper to stand the strain of passing through the press. The average speed was 12,000 papers an hour.

The pressure on the newspapers demanded larger than eight-page papers. It became necessary to devise some way to print 10-, 12-, 14- and 16-page papers at one impression. About this time Anthony and Taylor of England patented devices by which the webs of paper could be turned over after printing on one side and the opposite, or reverse side, presented to the printing cylinder. Mr. Hoe bought the patent rights for England and the United States, and with them combined ideas patented by Luther C. Crowell of Boston, who had made a machine for forming paper bags. After costly experiments these ideas were incorporated in a so-called "Double-Supplement" press, which was set up in the New York *Herald* office. Simplicity, speed, accuracy and efficiency had been combined. This press turned out either 4-, 6-, 8-, 10- or 12-page papers at the rate of 24,000 an hour; the odd pages were accurately inserted and pasted in; the papers were cut and delivered folded. This press was really two presses built into one frame. In the secondary part the plate cylinders were half the length of those in the main part and at right angles to them. These were used for the supplements of two or four pages when it was desired to print more than eight pages. Each part was fed by its individual roll of paper. The plates being secured to the cylinders, the two rolls of paper were carried, each through its part of the machine, between two pairs of plate cylinders and impression cylinders and printed on both sides. Then the two webs of paper passed over turning bars, or "angle bars," with an edge at 45 degrees from its base, by which they were laid evenly and exactly one over the other as a brush from the paste fountain glided along the inner fold, pasting them together. The papers passed on down a triangular "former" that folded them along the centre margin. Thence the printed and folded web of paper passed over a cylinder, from within which a revolving blade projected and thrust the paper between folding rollers, while at the same moment a knife in the cylinder severed the sheet. A rapidly revolving mechanism, resembling in its motion the fingers of a hand, disposed of them accurately on traveling belts that hurried them on to final delivery. Hundreds of this press have been built and operated in this country and abroad. Their efficiency was increased about 1900 by an automatic stereotyping machine called the autoplate (q.v.).

Magazine Presses.— The demand for a higher grade of rapid printing adapted to magazines has been catered to by the Cottrell Company, which has brought out an entire series of rotaries, less rapid than the newspaper machines, but executing a very high grade of illustrated printing. Hoe, Goss and Scott also built presses of this character.

Straight-Line Presses.— The angle-bar press stood alone for a decade as having the only device, though somewhat cumbersome, for assembling the several sheets into one complete paper. Joseph L. Firm, foreman of the press-room at Frank Leslie's publishing house, however, solved the problem in a new way, and in 1889 patented the straight-line press. His first design was a simple tandem press. Three sets of cylinders were set in a straight line, and the printed product of the first passed over the second, and of the first and second over the third, thus assembling all three sheets over a triangular "former" for folding, cutting and delivering. It was but a step, to secure economy of construction and space, to build the press in tiers instead of tandem. Firm had the usual fortune of poor inventors. His first order, which was for a sextuple press, came from the New York *World*, and its building exhausted his resources. When set up, in 1891, it was so crudely and badly built that, failing to work properly, it was condemned. Poverty followed, but not for long. The Goss Printing Press Company of Chicago became interested in the straight-line press invention, which was being pirated, and bought it, taking Mr. Firm into the company. Litigation followed and established the patent and harmony among the printing press makers. Improvement was rapid. These presses mark the final development of the power printing press. Evolution and the requirements of the publishers of metropolitan newspapers have brought forward presses with various improvements of detail and in increasing sizes, until one press, so-called, is a compound of two, four, six, eight, 12 presses built into one frame, one above the other, side by side or tandem, or all three for economy of space and power and efficiency, but the basic principle is the same,— a web of paper passes between two pairs of plate and impression cylinders and is printed on both sides; it is assembled (if on a double-supplement press or one of greater power), pasted, folded, cut or separated, folded again and delivered ready for the carrier or mail-room, at a speed of 48,000 eight-page papers (the unit of manufacture) an hour; and with an accuracy that denotes exactness and skill of manufacture, excellence of material and utmost care and nicety in adjustment and operation.

The first improvement in the Hoe type of fast press was the quadruple (or four-fold) press built for the New York *World* in 1887. A further advance in 1891 produced the sextuple (a six-fold press), so constructed that the cylinders were all parallel. Its delivery capacity was 72,000 eight-page papers in one hour, or 20 a second.



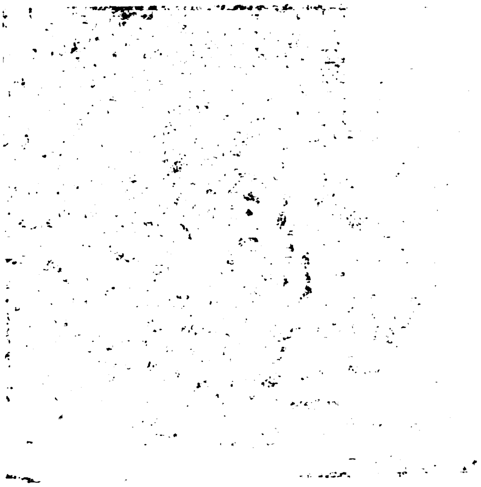
THE GOSS THREE-DECK STRAIGHT-LINE PRESS.

FIG. 4.— Diagram of the sextuple unit. Dotted line shows the course of the three webs of paper, which are assembled on the triangular "former" or folder. This press is two plates wide, has a capacity of 24,000 four-, six-, eight-, 10- or 12-page papers an hour; or 12,000 16-, 20-, or 24-page papers. It weighs 42,000 pounds and requires 40 horse-power.

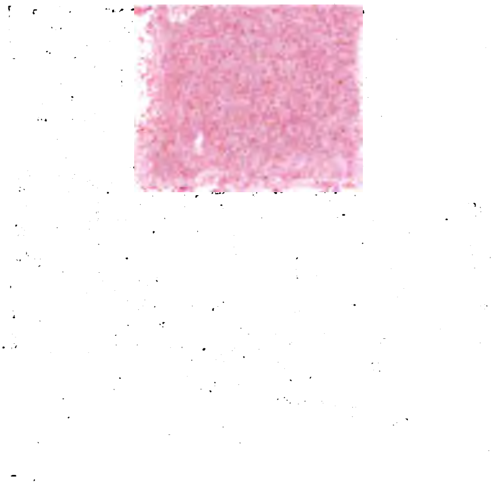
In 1896 an octuple (eight-fold) press was built for the New York *World,* with a corresponding increase in output, and four double sextuples, with color-printing attachment, were constructed for the New York *Journal.* Even larger are the six giant double-octuple presses which R. Hoe and Company designed for *Lloyd's Weekly,* and other great newspapers continue to purchase these enormous presses.

The 1902 patterns of the Goss press carry also "color decks," being an arrangement of two extra pairs of cylinders on the top of the machine, enabling the printing of three colors on the first and last pages of the newspaper. Two large Goss presses now in use are in the office of the New York *Herald,*— called duodecuple, or 12-fold. The *Herald* had two octuple presses and needed another. Its available floor space was entirely filled. The makers proposed to build in the air, as the pressroom was lofty, rising above the street level, and did on the same framework build another quadruple press on top of each of the octuples. Each press is now really made up of three quadruples, in tiers. Each can be operated individually; each delivers individually, the top press being fed and delivering its product on the mezzanine floor. In 1903 the New York *Herald* increased the size of its paper from a six-column page to a seven-column page. It was able to make over its presses to accommodate the increased width of the web, though web and cylinders now barely clear the framework. The Duplex Company of Battle Creek, Mich., manufactures what they term a "tubular" perfecting press, in which the plate cylinders are reduced in diameter, becoming literally tubes, that print continuously. These presses are very speedy. H. A. Wise Wood brought out in 1917 an improved perfecting press designed to reduce the strains on the web of paper and permit more rapid printing.

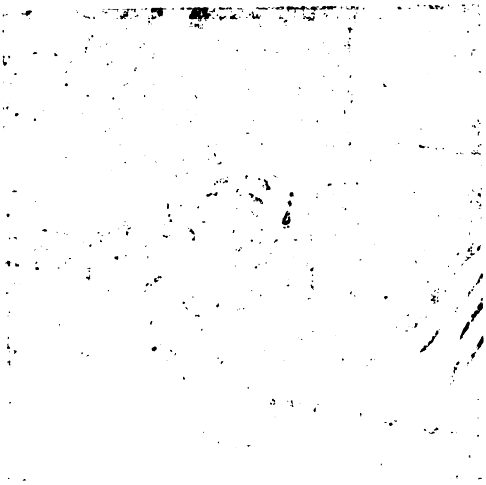
Newspaper Color Presses.— Ever searching for new features, New York newspaper publishers in 1902–03 were planning and designing supplements and main sheets embellished with color printing. Their scientific pressmen and the press-builders were called on to produce the desired effects. Walter Scott of Plainfield, N. J., designed and built a very efficient press that was set up in the office of the New York *World* in 1893. This had five two-page wide color cylinders for electroplates set tandem, with a pair of cylinders for printing the reverse side in a single color, usually black. Below was a complementary stereotype cylinder machine for printing four pages in a single color; so that this machine could produce either a four-page paper, one Christmas supplement showing outside pages in five colors and the inside in a single color. By skilfully dividing the ink fountains and combining colors and over-printing, many shades are produced in the same paper, one Christmas supplement showing no less than 36 shades. This press was removed to the office of the *Post-Dispatch,* in Saint Louis, in 1902, where it is still doing very efficient work. To meet increasing demand *The World* had R. Hoe and Company build an angle-bar double color-press in 1894, each side of which printed four (the two outside and the two inside) pages in four colors, and four pages in a single color; and another, a straight-line press, in 1898 with a capacity for four pages in five colors, and four pages in two colors; these two eights can be collected and delivered as a



1. The Original Print



3. The Red Plate



5. The Blue Plate

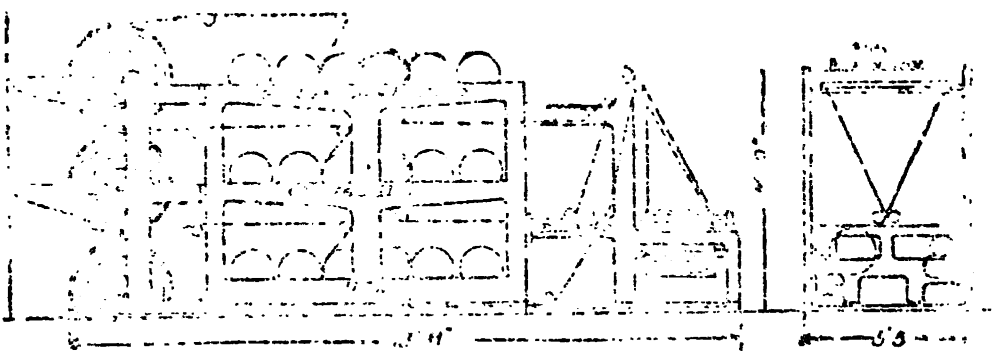
6. Combination [illegible]

Showing the different steps in obtaining a picture in colors from a

[illegible]

[illegible] the New York Herald [illegible] from a six-column [illegible] column [illegible] the web through [illegible] the framework. The [illegible] plate cylinders are reduced in diameter, [illegible] tubes, that [illegible] These presses are very [illegible] in 189[illegible] an improved [illegible] press designed to reduce the strain [illegible] web of paper and print [illegible] rapid [illegible]

Newspaper Color Presses.—[illegible] New York [illegible] 189[illegible] were [illegible] and [illegible] Their [illegible] to [illegible] the desired effects. Walter Scott [illegible] press that was set up in the office of [illegible]

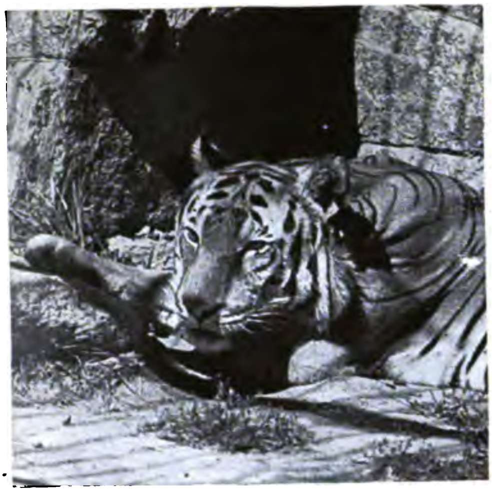


[illegible]

[illegible]

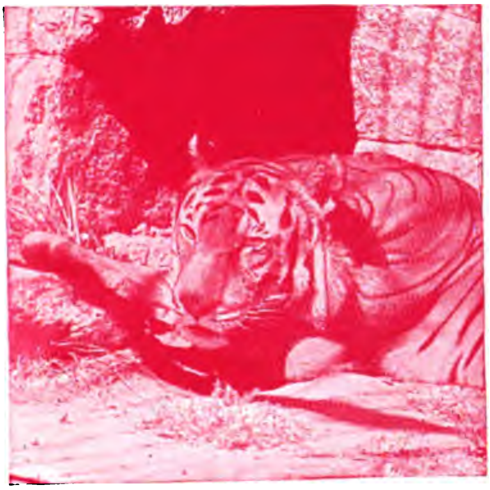
In 18[illegible] the New York [illegible] the New York Herald. [illegible] the six [illegible] and Company [illegible] colors [illegible]

[illegible] York Herald [illegible] color [illegible] stereotype [illegible]

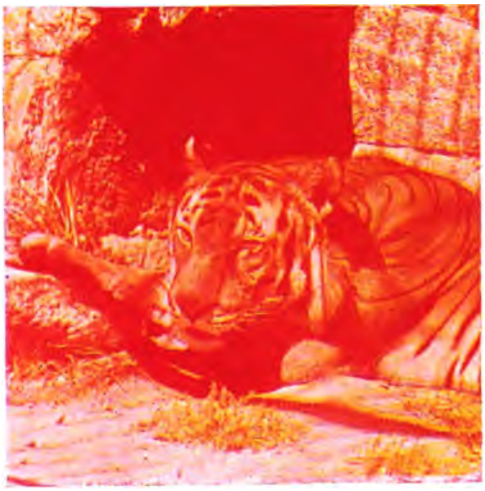


1. The Original Print

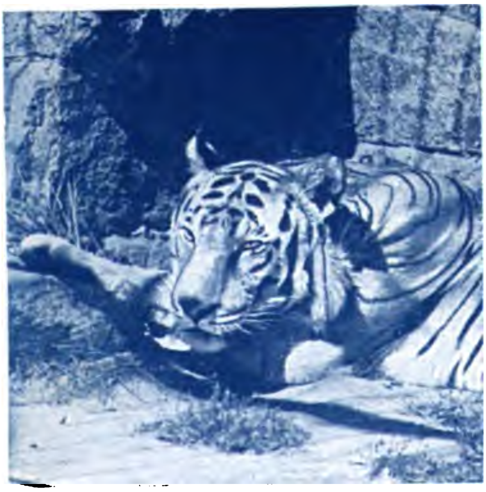
2. The Yellow Plate



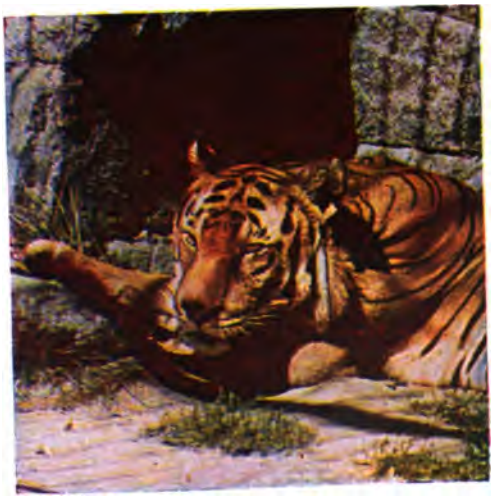
3. The Red Plate



4. Red and Yellow Combined.



5. The Blue Plate



6. Combination of the Three Colors.

Showing the different steps in obtaining a picture in colors from a single negative

16-page paper. The press will also produce a 24-page paper with four colors.

Color printing presses have been widely adopted by the American newspapers, and in the new models all the manufacturers offer «color decks.» The popularity of these colored sheets created a demand for illustrated supplements of pictures in one color. This has been supplied by what are called magazine webs and also by machines of the offset type, producing rapid photogravure work.

The skill of the American printing press manufacturers has produced so many designs, adapted to meet every demand of newspaper publishers, large and small, that it is impossible to enumerate the patterns. The presses here illustrated are sufficient to show the types.

In 1918 there were more than 80 factories in the United States producing printing presses, and 56 which made both printing and binding machines. The gross annual production of the former is over $8,000,000, and of the latter over $3,000,000. (See NEWSPAPERS, AMERICAN; PRINTING; PRINTING TRADE, AMERICAN). Consult Hoe, Robert, ‘Short History of the Printing Press’ (New York 1902), and Hoe, R. M., ‘Literature of Printing’ (London 1877). Consult also works referred to under article PRINTING.

CHARLES H. COCHRANE,
Author of ‘Modern Industrial Progress.’

PRINTING TRADE, American. Although the printing trade had its inception in America considerably prior to the Revolutionary War, it was not until some time after the conclusion of that struggle for liberty that it began to assume the proportions of a national industry. In the year 1775, for example, there were less than 100 printing establishments upon American soil, and these were almost exclusively confined to the coast towns. Even as late as the year 1810 there were but 35 printing shops scattered about throughout the interior of the country, while, in 1775, with the exception of the two or three offices that were located in Massachusetts and Pennsylvania, the art of printing had no inland representation. A few years later a printing establishment was opened at Lexington, Ky.; another soon followed at Pittsburgh, Pa., and the third office was finally located at Cincinnati, Ohio. In almost every instance these printing offices were established for the primary object of printing newspapers, although each of them not only possessed the necessary facilities for the production of job-work, but were also able to print and bind books on the rare occasions upon which such contracts presented themselves.

From the earliest days in the history of the printing trade in America, New York, Philadelphia and Boston have been the three great centres of this industry. Other seaport towns had their local shops, but the bulk of their business was small. In fact, during the first 50 years in the life of the new nation it was Philadelphia that took the lead in every branch of the printing industry, and by the beginning of the 19th century the Quaker City presses, of which there were no less than 110 constantly in operation, were producing more English publications than any city in the world, with the single exception of London. It was here that Matthew Carey, the first great American publisher, established his plant, and with all its daily and weekly newspapers, and its book-printing and binding establishments, Philadelphia was indeed the most important centre of the American printing trade.

Gradually, however, as the demands for printed works increased other cities came into line, Albany, Hartford and Worcester being among those that developed a comparatively large trade. Their chief industry was in the printing of pamphlets. The newspapers of that day contained so little matter that they were easily read, and, as they were passed from man to man, their numerical circulation was extremely small. As the result, therefore, little effort was made to enlarge them, and persons who, like the politicians, wished to reach the general public were compelled to address themselves to the people through the medium of pamphlets. So far as actual literature was concerned the country was practically devoid of authors, and the books which were printed upon American presses were almost exclusively those which had been pirated from English publishers. Later some religious and technical books appeared, but it was many years before general literature displayed any marked development.

In the beginning everything that was used in the art of printing was imported from England. The American printers had English presses. It was from England that they obtained their type. Even the better qualities of printer's ink were imported, for the ink that was produced in the United States was of such an inferior grade that it could be used only in the roughest kinds of jobs. From time to time various American printers made some slight improvements upon the old presses, but no great evidence of progress was shown until the establishment of a permanent type foundry.

Although it was the latter part of the 18th century before there was any permanent establishment for the making of type in the United States, several attempts had previously been made to introduce such an innovation in the printing trade. As early as 1775 Benjamin Franklin had sent the complete equipment for a type foundry from Paris, but the attempt to establish this branch of the industry was not a financial success, and it was accordingly soon discontinued. Some 10 years later a Scotch firm opened a foundry in Philadelphia, but it did not thrive, and the few other scattered efforts that were made to provide American workmen with American-made type met with the same fate. In 1796, however, two Scotchmen opened a type foundry in Philadelphia under the firm name of Binny and Ronaldson, and, as the time now seemed ripe for such an establishment, they were sufficiently successful to be able to continue operations. In 1805 another foundry was opened by the firm of Wing and White, in Hartford, but they found themselves unable to compete with the Philadelphia foundry until, in 1810, the establishment was removed to New York. Two years later the firm of David and George Bruce established a stereotyping plant in New York, and, when the already established foundries refused to supply them with type for their operations, they began to cast it for themselves, and soon became one of the most successful type-making houses in America. Their success, in fact, as much as the increasing demand for type, inspired others to follow their example. In 1816 a foundry was established in Boston; in 1817 another was opened in Baltimore, and, by 1830, there were no less than 12 foundries in full operation in various parts of the country. At the present time there are about 30 of these foundries in the United States, many of which are under the control of the American Type-Founders Company.

In the early days of the printing trade in America stereotyping was, of course, unknown, and the local publishers were accordingly compelled to recompose the type for each new edition that might be required. The introduction of stereotyping by the Bruces in 1813, therefore, suggested such economy that the enterprise could scarcely have failed to meet with favor at the hands of the printers. While the plaster process, the first method of stereotyping in vogue, was invented in England by Lord Stanhope, tidings of this great discovery were soon brought to America, and David Bruce at once set sail for the Old World for the express purpose of securing the information that would enable him to make practical use of the new invention in America. Although the stories that had reached the United States had pictured the new discovery as a perfected invention, Lord Stanhope's experiments had actually by no means been concluded, and, as the result, Bruce found it impossible to acquire anything more than the most superficial knowledge concerning the process. Finding that all material facts were being withheld from him, and that it would be useless to attempt to persuade Lord Stanhope to disclose his secret, Bruce returned to the United States. So far from admitting his defeat, however, he promptly went to work, and, with the little information he had obtained, he managed by his own genius and mechanical skill to make a plate that was in every respect superior to any that had as yet been cast in England. Through his own diligence he had mastered the defects which Lord Stanhope had been unable to overcome, for his plate was not only perfectly level on both sides, but it was of uniform thickness in every part. In fact, so successful was he that an Englishman named Watts, who had succeeded in learning his process, went back to Europe with his knowledge. There he found scores of master-printers who, disgusted with the English invention, were glad to be taught how the American plates were made, and it was through his efforts that both Austria and Germany acquired the art of stereotyping.

From the day on which David and George Bruce opened their foundry in New York they had all the orders that they could fill, for American publishers were quick to appreciate the economical advantage of the new invention. It was the time when the public was just beginning to demand books, and as the plaster casts were not only made without great expense but also guaranteed plates of great durability, printers were eager to stereotype all books that might by any possibility require a second edition. From this simple beginning, therefore, came the great stereotyping industry of America. By 1850, the year in which the making of plaster plates attained its greatest development, there were more than 50 firms engaged in this business in the United States, while more than 1,000 men were employed in the work. Then came the modern improvements — the electrotyping for book-work and the introduction of the papier-mâché process in the making of newspapers — since which time the making of plates has become practically an art by itself.

Prior to 1805 comparatively little printer's ink was made in the United States. Although printers were supposed to know how to mix the compound the preparations that they concocted proved such a poor substitute that all the good inks were imported. In 1805, however, two firms — one in Philadelphia and the other in Cambridgeport — began the manufacture of printing ink, and, since that time, the industry has been steadily extended until there are now about 35 firms engaged in this branch of the printing trade. About 1860 the cheapness of aniline colors inspired a more general use of colored inks, but as many of these tints soon lost their brilliancy they did not become very popular until the chemists had succeeded in correcting this fault.

The period between 1819 and 1833 witnessed many great improvements in the art of printing. One of the most important innovations was the substitution of iron for wood in the making of hand presses. Although wooden presses had been used since the time of Gutenberg they had always proved a handicap to good printing. Even the strongest wood was weak, and as the machine was liable to give way in some part at any pull, the pressman found it impossible to obtain a good impression, even when the type surface was no larger than 12 by 20 inches. As the natural result, all hand-presses were small affairs, and as they required the services of two expert workmen to keep them going the process was as costly as it was slow. In the adoption of the iron press American printers followed the example of their English brethren. The first iron press to be made in America was completed about 1820, but, sometime previous to that date, such presses had been imported from England. Recognizing the advantage of a machine that was capable of printing a sheet three times as large as the old press and with no greater muscular effort, American printers soon demanded them, but, in spite of this demand, it was several years before the wooden presses were relegated to the junk-heap, some of them having been in use, even in New York, as late as 1850. In the beginning presses were made by Turney, Worrall, Wells and Smith, but gradually the business began to centre with Hoe in New York and Ramage and Bronstrup in Philadelphia, until, finally, nearly all the presses were manufactured by these houses.

Another invention that proved an invaluable aid to the progress of the art of printing was the making of elastic rollers for inking the type. The original method of inking was a most laborious system, the application of the ink being made with balls of pelt. Early in the 19th century, however, an English compositor discovered that a composition of glue and molasses, long used in the making of pottery, could be applied in the inking of type, and from this idea was evolved the composition roller which was so necessary to the success of the first machine presses. This roller was first employed in America about 1826. Another invention that played an important part in the production of cheap printing was the improved method of paper manufacture which came with the introduction of Fourdrinier's machine. This, too, was introduced in America soon after 1826, and since that time the growth of the printing industry has been a steady and rapid evolution.

Of course, the great necessity under the new conditions was more rapid printing facilities, and this demand was met by the inventors about 1829. Some 15 years prior to that time a German printer named König went to England to produce a cylinder machine for the use of the London *Times*. While the press that he constructed was rather successful, he returned to Germany before it was perfected, leaving the English inventors to complete the improvement of his work. This they did in many respects, but the credit for the first actual success in the making of cylinder presses is due to the American manufacturers, firms like R. Hoe and Company, who took the somewhat unsatisfactory foreign machines and brought them to a state of comparative perfection. By depending only upon good material and thorough workmanship they produced cylinders that were so much more satisfactory than the foreign goods, that, in spite of the fact that the home product is cheaper, English printers have long found it expedient either to import American printing machines, or to make their own presses from American models.

After 1833, therefore, America needed no further help from England in the development of her printing industry. With the best of paper, ink, type and presses, all made in the United States, and with plenty of money to invest in manufacturing enterprises connected with this trade, it was unnecessary for her to turn to any foreign nation for assistance, and when, in 1830, the system of cloth book-binding was introduced, all the requisites for literary progress were in her own hands.

Of course, with the development of the power press the character of the newspapers of America also began to change. Whereas they had originally been small and dull, having but little news in them, the ability to print many copies enabled them to increase their circulation, as well as their size. In 1833 the New York *Sun*, printing a sheet 11½ by 17 inches on a hand press, could not produce more than 400 copies an hour. As the demand for the paper continued to increase, however, a cylinder press, propelled by a man at a crank, was introduced in 1834, and a year later this was supplanted by a double-cylinder operated by steam power. As other papers in other parts of the country met with similar experiences, the demand for rapid newspaper presses continued, and, by 1845, it was found that even the double-cylinder machine was too slow for the requirements of the constantly growing circulation of the great dailies. See NEWSPAPERS, AMERICAN.

It was to comply with this demand that R. Hoe and Company, in 1847, invented the type-revolving rotary printing press, a machine in which the type was fastened to the cylinder and successively presented to each of the impression cylinders placed around it. For more than 20 years this press was able to meet every demand of periodical publications, but, in 1869, finding that it had at last become too slow, R. Hoe and Company perfected their web-printing machine, a press which prints continuously from stereotyped plates on a cylinder against an endless roll of paper. In spite of the almost incredible speed at which this press can be run, other inventions, which have since been perfected, now enable it, not only to print 4, 8, 12 or even more pages, but at the same time, to fold, count and paste them; to insert sheets or add the necessary covers, or even to print illustrations in many colors. In 1854 William A. Bullock perfected the first cylinder machine that was capable of printing a newspaper from a roll on both sides at the same time, but the other improvements have been the work of R. Hoe and Company, or some of their business rivals like Cottrell, Babcock, Campbell, Potter, Huber, Miehle, Joss and others.

Great as has been the improvement in the making of machine-presses, however, the other branches of the art of printing have succeeded in keeping pace with it. In stereotyping, for example, the invention of the papier-mâché process enabled printers to make a number of impressions of the same page of type, while the demand for a convex plate was met, in 1854, when Charles Craske of New York succeeded in stereotyping a curved surface.

The period between 1833 and the outbreak of the Civil War also witnessed many improvements in the art of printing, the most important being the introduction of fast printing in fine book and job work. The invention of the power press had been a blessing to the newspapers, but, for a long time, book and fine job work was still done on hand presses. It was not until 1836 that Harper and Brothers introduced a power press, although Daniel Fanshaw of New York, the printer of the Bible Society, had 10 power printing machines in operation in his shop prior to that time. These machines were manufactured by Daniel Treadwell of Massachusetts, and, although they were both bulky and inconvenient, they were the best presses on the market until the Adams press came to take their place. During all this period, however, it was believed that cylinder machines were incapable of doing fine work, and it was not until Francis Hart of New York had demonstrated the fallacy of this theory that the incredulous could be persuaded to make the change which the proper development of the trade had so long demanded.

To Joseph A. Adams belongs the credit of devising the American method of making-ready woodcuts, and he it was who first demonstrated the feasibility of the new process of electrotyping by making successful electrotype plates, in 1839. It was in 1838 that the typecasting machine was invented by David Bruce, and about 1850 that the method of printing illustrations on dry paper was discovered.

The art of engraving on wood was practised until comparatively recent times, but the introduction of the art of photo-engraving destroyed its usefulness, for, while wood engravings were extremely costly, the new process made the cheapest of illustrations possible. Lithography, or the art of printing upon stone, has been employed in the United States since 1819. It was not until 1825 that its use became commercially practicable, but since that time this form of printing has developed rapidly.

One of the latest, and, unquestionably, one of the greatest improvements in the art of printing was the invention of the typesetting machine, which is now in such general use in all large establishments that it may be said to have practically supplanted hand composition. It is by such inventions, however, that the printing trade has been revolutionized until it has grown from the small proportions of a business which engaged the attention of less than 500 men to a great national industry.

Printing has increased in volume as much as in quality. In 1900 it was rated as about the 14th United States industry; in 1914 the census returned it as the sixth industry. In 1918 Charles Francis, generally known as the «dean of the printing industry» in America, called attention to the fact that it was entitled to be classed as the third industry of the country, and from some points of view as the second industry. He reminds us that paper is a very necessary part of printing, and that its value has been usually deducted in computing printing production. When gross products are figured the leading United States industries appear as follows, 1914 figures: (1) Slaughtering and meat packing, $1,673,000,000; (2) foundry and machine shop products, $1,373,000,000; (3) printing and publishing, $1,233,000,000; (4) lumber and timber, $1,119,000,000.

When measured by net products, foundry and machine shop products comes first, and if the paper be included printing and publishing is second. The motion-picture industry is now approaching rapidly and bids fair to occupy one of the foremost places. In number of employees drawing wages and salaries, printing, publishing and paper, considered as one industry, ranks third, and in wages paid come second. From the same point of view, in capitalization, foundry and machine shops are first, and lumber and timber, steel works and printing (with publishing and paper), are practically tied for second, third and fourth place. It also appears that one-fourth of the printing in the United States is done in the metropolitan district of New York, while Chicago, Philadelphia and Boston together do another fourth. The total gross United States production of printing and publishing and the paper used in 1914 was $1,233,000,000, which figure does not include paper used for other purposes. The newspaper end of the industry is discussed under American newspapers. The magazines and periodicals, meaning the larger weeklies and nearly all the semi-monthlies, monthly and quarterlies, are produced by what is commonly called the book and job printing branch of the industry, but which is beginning to be known as the periodical, book and job printing branch, because the periodicals constitute the largest portion of its production. The great daily newspaper printing plants and the great printing houses that turn out periodicals, catalogs and books in large numbers, have all developed along factory lines of efficiency, and may correctly be classed with other factories.

Charles H. Cochrane,
Author of ‹Modern Industrial Progress.›

PRINTZ, Johan, yō'hän prints, Swedish colonial governor in America: b. Bottneryd, Sweden, about 1600; d. 1663. He fought in Germany in the Thirty Years War with the rank of a lieutenant-colonel of artillery in the Swedish army, but having surrendered Chemmitz in Saxony to the enemy, was deprived of his rank. In 1641, however, he regained the good will of the Crown, was raised to the nobility and made the third governor of the colony established by the Swedes on the Delaware River in 1638. He landed at Fort Christina in 1643 and until his departure from the colony in 1658 maintained the prosperity of the settlement, upheld the Swedish claims, almost unaided, against the English under Sir Edmund Plowden and Lamberton, and against his near neighbors, the Dutch. He built forts on the island of Tinicum near the mouth of the Schuylkill below Philadelphia, at Wilmington, and at New Castle, exerting much influence over the Indians along the Delaware and protecting his trade with them. At Tinicum he built himself a rude mansion, known as «Printz Hall.» The influx of settlers during his rule was made up of a good class of farmers who dealt fairly with the Indians and established a precedent of kindliness and justice acted upon so successfully afterward by William Penn. The only record of Printz after he returned to Sweden is that he was made a general, and in 1658 was appointed governor of Jonköping. Consult Acrelius, ‹History of New Sweden› (extracts in ‹Old South Leaflet,› No. 96); Smith, ‹The Thirteen Colonies› (1901); Winsor, ‹Narrative and Critical History of America› (1889).

PRINZIP, Gabrilo, Serbian assassin: b. Serajevo, Bosnia, about 1893; d. a prisoner in an Austrian fortress near Prague, 30 April 1918. Though an Orthodox Serb and a member of the Greater Serbian party, he was an Austrian subject, the son of a small innkeeper of Serajevo. It was he who fired the three shots from a Browning pistol which killed the Archduke Francis Ferdinand of Austria and his morganatic wife, the Duchess of Hohenberg, in Serajevo on 28 June 1914. At the time a mere schoolboy and a printer's «devil,» Prinzip may be credited with having precipitated the European War by furnishing the Austrian government with a suitable pretext for war against Serbia. He was immediately arrested after firing the shots and subsequently sentenced to imprisonment for life. Prinzip confessed, on 2 July 1914, that he had previously informed the Pan-Serbian Union of his intention to murder the Archduke.

PRIONIDÆ, a family or subfamily of longicorn beetles distinguished from its allies by the margined and usually toothed thorax. They are mostly insects of large size and robust form. Their larvæ are large, soft grubs with small heads but powerful jaws, which bore in wood and are very destructive. They rest in a nearly straight position, not bent or doubled. A number of conspicuous species are found in the United States, several of the most common belonging to the genus *Prionus*, in which the thorax bears three marginal teeth on each side, the joints of the long antennæ fit into one another in an imbricate fashion and number from 12 to 27. These insects are nocturnal, and the males are said to fight fiercely for possession of the females. One of the largest species is *P. brevicornis*, a common black beetle, which flies about in a heedless fashion at dusk. The huge larvæ, as large as a man's finger, live for three years; and are very injurious to the roots of poplar and other trees. A smaller and more slender beetle is *Orthosoma unicolor* which bores passages through the roots of grape vines.

Other species are less destructive, confining their attacks chiefly to the dead wood of stumps and decaying tree trunks. Consult Fabicius, 'System Eleutheratorum'; Olivier, 'Entomologia ou Histoire Naturelle des Insects'; Gyllenhal, 'Insects Suecica'; Dejean, 'Species Général des Coléoptères.'

PRIOR, prī′ŏr, **Matthew**, English poet and diplomatist: b. Wimborne Minster, Dorsetshire (possibly Winburn, Middlesex), 21 July 1664; d. Wimpole, Cambridgeshire, 18 Sept. 1721. He was educated at Cambridge, and in 1688 was chosen fellow of his college, Saint John's. With Charles Montague he wrote in 1687 'The Country Mouse and the City Mouse,' a parody of Dryden's 'Hind and Panther.' Through the Earl of Dorset he was appointed secretary to the English plenipotentiaries at The Hague in 1690; in 1697 he became secretary to the commissioners who concluded the Peace of Ryswick, and on his return from The Hague, secretary to the lord-lieutenant of Ireland, and finally Under-Secretary of State. In 1699 he produced his 'Carmen Secular for the Year 1700.' He succeeded John Locke as commissioner of trade and plantations and sat for a short time in Parliament. At the beginning of the reign of Anne he left the Whigs to join the Tories. Made commissioner of customs in 1711, he was employed in secretly negotiating at Paris the terms of the Treaty of Utrecht, and he remained in France as secret agent and Ambassador till 1714. On the accession of George I, he was impeached on the charge of high treason and kept in custody two years in his own house. During his imprisonment he wrote 'Alma, or the Progress of the Mind,' which, together with his more ambitious work, 'Solomon,' was published in 1718. Having been rendered nearly penniless, he published a folio edition of his poems by subscription. He was buried in Westminster Abbey. Prior made his way chiefly by his wit and social qualities. His poetical powers were at their best in short occasional pieces in the flowing ease and vivacity of narration. Consult Aldine edition of 'Prior's Poetical Works' (1892).

PRIOR, the chief coadjutor of an abbot in the government of an abbey, or the actual ruler of a monastic establishment. Not till the 13th century was prior used as a term significant of authority of rule, but rather of superiority of any kind, as experience, wisdom, advanced age. Till that time the abbot's coadjutor was styled *præpositus* (provost), but now he was called prior and under him in great abbeys was the sub-prior. Then, the head of a small monastery, of Benedictine monks, for example, was called prior. Finally, the chief officer of a convent of Augustinians, or Dominicans, or Premonstratensians, had the same title, while the corresponding officer of a Franciscan house was known as *custos* (guardian); but the heads of houses of the military orders of Saint John of Jerusalem, of Malta and of the Temple were given the title of grand priors. In church history priors are of two kinds: conventual and claustral. A conventual prior is the head of a religious house, either independently, as among the Regular Canons, the Carthusians and the Dominicans, or as superior of a cell or offshoot from some larger monastery. In the former sense he has generally a sub-prior under him. A claustral prior is appointed in houses in which the head is an abbot, to act as superior in the abbot's absence and to maintain the general discipline of the house. Prioresses in religious houses of women, whether abbeys or simply conventual establishments, had much the same authority as priors in religious orders of men.

PRIPET, prĕp′ĕt (Russian, *Pripyat*), a river in the western part of Russia. It has its rise in the government of Volhynia, and is the outlet of several lakes; flows east and southeast and enters the Dnieper. It is about 500 miles long; navigable over 300 miles and is connected with the Vistula and the Niemen by canals. Its upper course is through a vast uninhabited forest region, with large areas of marsh lands. What has become known historically as the Pripet Marshes was the scene of a great offensive movement in the World War by the Russians under General Brussiloff and the Germans and Austrians under Field Marshal von Hindenburg. The Russian operations opened on 3 June 1916 and extended along the entire front from the Pripet Marshes to the Rumanian frontier. The Russians were the first of the Entente Allies to resume the offensive on the Russian front and this was their first signal blow, resulting in the achievement of sweeping successes. Between 4 and 23 June the Russians captured 4,031 officers, 194,041 men, 219 guns, 644 machine guns, 196 bomb mortars, 146 artillery ammunition wagons and 38 searchlights, and cleared all of Bukovina of the enemy.

PRISCIAN, prĭsh′ĭ-an (Latin, PRISCIANUS CÆSARIENSIS, prish-ĭ-ā′nŭs sē-zā-rĭ-ĕn′sĭs), Latin grammarian of the 6th century A.D. From his surname "Cæsariensis" it is supposed that he may have been born at Cæsarea, and it is believed that he lived about 500 A.D, as he is mentionel by Paulus Diaconus as contemporary of Cassiodorus (468–562). Almost all that is known of the facts of his life is that he taught Latin at Constantinople, probably to the imperial court of Justinian, as he is known to have received a salary from the government. His 'Institutiones Grammaticæ,' in 18 books, a most thorough and comprehensive work, has chiefly preserved his fame. A transcript completed at Constantinople by one of his pupils in 527 was reproduced in 1,000 manuscripts in the Middle Ages. Priscian borrowed largely from the first 12 of the 20 chapters of the 3d century 'De compendiosa doctrina' of Nonius Marcellus (q.v.), who was especially indebted to Verrius Flaccus and Aulus Gellius, and a revised and annotated edition of whose work was brought out by Julius Tryphonianus Sabinus in the 5th century. Priscian's 'Institutes' and the grammar composed by Aelius Donates in the 4th century dominated the schools of the Middle Ages and formed the type and source of the Latin and Greek school grammars of modern Europe. The first 16 books treat of the eight parts of speech recognized by the ancient grammarians. The last two are on syntax and are preserved separately in one manuscript, these bearing the title 'De Constructione.' The whole work, successively abridged, formed the basis of instruction in Latin up to the 15th century. The old phrase, "to break the heart of Priscian," means to violate grossly the rules of grammar. The first edition of his complete works appeared at Venice in 1470, and what has been considered the best, by Krebel, at Leipzig (2 vols., 1819–20). See LANGUAGE, SCIENCE OF.

PRISCILLIAN, prĭ-sĭl'ĭ-ạn, Spanish religious sectary: b. about 350; d. Treves, 385. He was charged with teaching heresy resembling Gnosticism or the doctrine of the Manichæans and was excommunicated by the Synod of Saragossa (380). However, he was able by his eloquence to cause the judgment to be withdrawn and put to flight his chief opponent, the bishop Ithacius. The bishop later gained the support of Maximus, the usurper at Treves, and secured the condemnation and execution of Priscillian. The followers of Priscillian were known as Priscillianists. Their beliefs included peculiar views of the influence of the heavenly bodies upon men. The sect did not die with its founder, though there was considerable reaction against it at the close of the 4th century, and it disappeared as an organized body before the end of the 6th century, though at all times through the mediæval period its traces appear under various names and forms, especially in northern Spain, in Languedoc and in northern Italy.

PRISM, *in geometry*, a solid consisting of the region intercepted by a number of planes, known as the sides, parallel to a given line and two planes, the so-called bases, parallel to one another. It has similar and parallel bases and its sides form similar parallelograms. The bases may be of any form, and this form (triangular, pentagonal, etc.) gives its name to the prism. *In optics*, any transparent medium, comprised between plane faces, usually inclined to each other. The intersection of two inclined faces is called the edge of the prism, etc., the inclination of one to the other, the refracting angle. Every section perpendicular to the edge is called a principal section. The prism generally used for optical experiments is a right triangular one of glass, the principal section of which is a triangle. It is used to refract and disperse light, resolving it into the prismatic colors. See LIGHT.

PRISON. See PENOLOGY.

PRISON ASSOCIATION OF THE UNITED STATES, National, an organization of reformers and philanthropists, founded in Cincinnati, Ohio, in 1870, under the presidency of Rutherford B. Hayes. There is a board of directors and an executive committee of seven. Meetings are held annually. There are standing committees on criminal law reform, prison discipline, juvenile delinquency, etc. The Association holds annual congresses at which the executive officers of penal institutions throughout the country and others engaged in prison work exchange experiences and discuss the problems that are constantly arising. The national and the various State associations are the outgrowth of a movement in New York City in 1846 which culminated in the organization and chartering of the Prison Association of New York. The purposes of all are substantially to protect the public against criminals; to reform criminals; to defend those accused unjustly; to give first offenders a probationary opportunity; to improve prison management; to provide employment for released prisoners; to aid families of prisoners; to exercise watchfulness over prisoners released on probation and parole, and to secure legislative action to make the purposes effective.

PRISON REFORM. See PENOLOGY.

PRISONER OF CHILLON, The, a narrative poem by Lord Byron based on the story of the imprisonment of François de Bonnivard (1496–1570) in Château de Chillon, situated between Clarens and Villeneuve on Lake Geneva, Switzerland. It was Sir Walter Scott's opinion that as a picture this poem, however gloomy the coloring, might rival any which Lord Byron had drawn. Bonnivard was the prior of Saint Victor, who, having by his efforts to free the Genevese rendered himself obnoxious to the Duke of Saxony, was carried off by emissaries of that potentate and confined for six years in the château, which was really a fortress, believed to have been built in 1238. He was liberated when the Bernese and Genevese forced the surrender of the stronghold.

PRISONERS OF WAR. Ordinarily a prisoner of war is a person belonging to the military and naval forces of a belligerent and who has fallen into the hands of the enemy by capture or otherwise. This definition, however, is both too broad and too narrow, since there are persons attached to an army who if captured cannot be detained as prisoners of war, such for example as chaplains, Red Cross doctors and nurses, while there are others who follow an army without being attached to it, yet who if captured may be held as prisoners of war, such for example as newspaper correspondents, reporters, contractors and the like. But to be entitled to the treatment accorded prisoners of war, The Hague Convention (Art. 13) requires that they must be in possession of a certificate from the military authorities of the army they are accompanying. Until 1907 seamen on a merchant vessel of enemy nationality if captured might be detained as prisoners of war, but The Hague Conference of that year adopted a rule exempting them from liability to be detained in captivity, provided they give a formal promise not to engage in military services during the period of the war. In case they are citizens or subjects of a neutral state they must be liberated unconditionally. The refusal for a time of the German government early in 1917 to release certain American seamen who had been captured while serving as members of the crew of a British armed merchant vessel was in contravention of this rule. On the other hand, the Germans refused to treat as prisoners of war the masters and crews of armed enemy merchantmen who exercised the right to defend themselves against attack by German submarines, and in pursuance of this theory they court-martialed and shot as a sea franc-tireur in 1916 Captain Fryatt, the master of an English Channel steamer, for defending his vessel against destruction by a German submarine. In like manner the Germans refused to treat as prisoners of war Belgian civilians who upon the approach of the German armies took up arms and resisted the enemy, without being under the command of responsible commanders and without being clothed in uniform, this in the face of The Hague provision which allows the civil population in such a case to rise spontaneously and endeavor to beat off the invader, subject only to the condition that they carry their arms openly and conduct their operations according to the laws and customs of war. The reason given by the Germans for refusing to treat such persons as prisoners of war was that they had sufficient time before the arrival of the German armies to perfect an organization and equip themselves with uniforms.

Practice, especially during the World War, makes a distinction between military prisoners and civil prisoners. The former category embraces captives belonging to the armed forces of the enemy; the latter includes enemy aliens arrested and confined in internment camps. The status of both classes of prisoners is essentially the same, however, and the treatment of them has been substantially the same.

In early times it was the custom to torture and even kill prisoners. It was considered a mitigation of their lot to reduce them to slavery, and consequently enslavement, especially among the Romans, came to be a common practice. During the Middle Ages the practice of ransom was introduced under which prisoners might obtain their release by the payment of a sum of money, or they were redeemed from captivity by the state of which they were subjects. But this practice is no longer followed.

The status of prisoners and the treatment which must be accorded them are now regulated in detail by The Hague Conventions of 1907 and especially the convention respecting the laws and customs of war on land. The latter convention at the outset condemns an ancient principle by laying down the rule that prisoners of war are in the power of the hostile government and not of the individuals or corps who capture them. They cannot, therefore, be ransomed or sold into slavery by the individuals who take them. They must be humanely treated. They may not, therefore, be beaten, tortured starved or cruelly punished. Still less may they be put to death, except for crimes punishable by death under the laws of the captor and after due trial and conviction, although the German war manual asserts that they may be killed whenever their presence becomes a danger to the existence of their captor. But the British and American manuals take occasion to express doubt whether such extreme necessities can ever arise that will compel or warrant a military commander in killing his prisoners on the ground of self-preservation. They may of course be punished for acts of insubordination and reasonable measures may be taken to prevent them from escaping. They may indeed be shot while attempting to escape, but if after having escaped they are recaptured they cannot be punished for having escaped. Prisoners are allowed to retain their personal property, except arms, horses and military papers. It is the duty of the government into whose hands they have fallen to feed and clothe them, and as regards board, lodging and clothing they are entitled to the same treatment as the troops of the government which holds them in captivity. The captor may require prisoners, except officers, to work according to their rank and aptitude, but their tasks must not be excessive and must have no connection with the operations of the war. Work done for the state must be paid for at the rates in force for work of a similar kind done by soldiers of the national army, or if there are none in force, at a rate according to the work performed. The wages so paid shall go toward improving their position and the balance shall be paid them after deducting the cost of their maintenance. Officers taken prisoners must receive the same rate of pay as officers of corresponding rank in the country where they are held, the amount to be ultimately returned by their own government.

The Hague Convention declares that prisoners may be set at liberty on parole if the laws of their country allow it, but those so liberated and recaptured while bearing arms against the government which released them are not entitled to the treatment reserved for prisoners of war. The Convention does not deal at all with the subject of exchanges. The Hague Conference of 1899 made it the duty of belligerents at the outbreak of hostilities to establish a bureau of information to answer inquiries about prisoners of war held by them, to collect and keep all objects of personal use, valuables, letters, etc., found on the battlefields and to furnish information to the parties interested regarding prisoners who have been released on parole, or exchanged, or who have escaped or died in hospitals, etc. The provision was renewed in 1907 and the scope of the bureau enlarged. Letters, money orders and postal parcels intended for prisoners of war, or dispatched by them, are exempt from postal charges in the countries of origin and destination as well as in those through which they pass. Finally, The Hague Convention requires that at the conclusion of peace the repatriation of prisoners shall be carried out as quickly as possible.

In all great wars the problem of caring for prisoners has been a difficult one and there have been few in which one or both belligerents were not charged with violating the law regarding the treatment of prisoners. Naturally during the World War when the number of prisoners taken ran into the millions the problem was very great and the charges and counter-charges in respect to ill-treatment have been numerous. Fortunately, in the early months of the war, arrangements were entered into between most of the belligerent governments by which each consented to permit representatives of neutral legations and embassies to visit their prison camps, conduct inspections and make reports to the governments concerned regarding the conditions of the camps in which their nationals were held as prisoners and the kind of treatment they were receiving. Until the United States entered the war, representatives of its legations and embassies in England, Germany, France, Russia and Austria performed this service. They visited the camps without giving previous notice, inspected the barracks, hospitals, kitchens, recreation grounds, etc., conversed with the prisoners, heard their complaints, made recommendations to the camp commandants and in this way were able to bring about many necessary reforms and improvements. Their reports constitute the most trustworthy sources of information regarding the treatment of prisoners that are available.

At the outset the various belligerent governments issued general regulations concerning the treatment which they proposed to accord prisoners held by them and those promulgated by the British and French governments announced that no distinction would be made between the treatment of interned civilians and regular military prisoners. These rules are quite elaborate and cannot even be summarized within the brief limits of this article. They related to housing, food, clothing, medical attendance, pay of officers, wages to be paid prisoners employed, postal facilities, recreation facilities and the like. In the beginning, serious complaints were made in England in regard to the housing facilities provided for British prisoners in Germany and the reports of representatives of the American embassy confirm in many instances the truth of the charges. So far as possible, prisoners captured by Germany were housed in the military barracks but during the early months of the war the number of prisoners captured by the German armies attained such proportions that it became necessary to house them in tents or in hastily constructed buildings which were poorly heated and equipped. As a consequence, the sufferings of the prisoners in the German camps during the first winter of the war were particularly severe. Unfortunately also the camp sites were not well selected, some of them being located on the sandy plains in North Germany where the climate was especially rigorous. According to the reports of the American representatives prisoners in England and France were better housed and their exposure to cold was less serious. During the first year of the war there were many complaints that German prisoners were inadequately clothed and that the supply of blankets was wholly insufficient. The American inspectors found this charge to be true in various camps and called the attention of the German government to the facts.

The most serious complaint, however, related to the quantity and quality of food rations served in the prison camps of Germany. British and French prisoners complained that the food was not only inadequate in amount but was of such a quality that they could not eat it. Food experts attached to the American embassy found this to be true in some of the camps but as to others they reported that there was no substantial ground for complaint. By the beginning of the year 1916 British and French prisoners were depending almost entirely upon the food which they received from home through the parcel post. Russian prisoners, however, appear to have received little or no food through this channel and were compelled, therefore, to subsist on the meagre ration furnished by the German government, which as the years passed became hopelessly insufficient.

Regarding the pay of prisoners who were officers, the British government at the outset allowed German officers half the pay of the corresponding ranks in the British army and without charging them for their subsistence. At the same time the British government offered to allow full pay provided Germany would reciprocate. To this offer, the German government never replied. Subsequently the British government learned that British officers in Germany were receiving only 60 or 100 marks per month according to their rank, from which approximately two-thirds was deducted for food. Thereupon the British government revised its scale of pay for German prisoners held in England and brought it into harmony with the German scale. The French government at the outset adopted the British policy in respect to the pay of officers but altered it later to conform to German practice. Taking advantage of the right recognized by The Hague Convention, Germany organized an elaborate prison labor system, more than 2,000 labor camps being established in various parts of the empire. By the end of the second year of the war it was estimated that between two and three million prisoners were working in the industries of Germany; in fact they largely replaced the millions of Germans who had been called to the colors. Where they were engaged in private work they were leased out to contractors. The rates of pay allowed appear to have varied in different camps and according to the skill of the prisoner, the most common wage being 30 pfennigs per day, although in some cases it was 80 pfennigs, and in a few as much as 1.25 marks. Generally, prisoners were compelled to work and naturally there were many complaints in respect to long hours, excessive tasks, brutality of treatment, starvation and the like. It was also a cause of complaint that the German government refused to permit neutral representatives to visit and inspect the working camps, so that the governments whose nationals were employed in these camps had no means of obtaining information regarding their treatment. There were also frequent complaints among the prisoners that they were compelled to work in industries that were engaged in the manufacture of war materials. In March 1918 the British government committee on the treatment by the enemy of British prisoners made a report which charged the Germans with systematically employing their prisoners in forced labor close behind the firing line on the Western front, thereby exposing them to the fire from the guns of their own and the allied armies. In April 1917 an agreement had been reached between the British and German governments that prisoners on either side should not be employed within 30 kilometers of the firing line. But the British committee charged that the agreement was systematically violated by the German authorities and that the prisoners held by them were sometimes put to work within 10 kilometers of the firing line, in consequence of which many were killed by the fire of their own troops. The excuse given by the German authorities was that they were driven to this cruel measure as an act of retaliation against the British for having themselves violated the agreement. This charge, however, was emphatically denied by the British government. In France as in Germany prisoners were employed not only in camp work but in planting, cultivating the fields, harvesting the crops, repairing roads, work in coal mines, quarries, etc. In Great Britain the same policy was followed although no such extensive system of prison labor was ever organized as was put into effect in Germany. In the United States prisoners were employed in camp work and in the construction of roads in the neighborhoods of the prison camps. Germany's prison population proved an asset rather than a source of expense, not only because of the elaborate system of compulsory labor which the Germans organized but because of the comparatively small outlay necessitated for the feeding of English and

French prisoners, since they depended mainly on the food they received from home through the medium of the parcel post.

Regarding postal facilities, all the belligerents placed restrictions upon the number and length of the letters which the prisoners were allowed to write. The British regulations allowed each prisoner to write two letters a week, each consisting of two pages of ordinary writing paper. In special cases the number and length of letters allowed were unlimited. No limitation was set to the number of letters which a prisoner might receive. The German regulations, however, allowed prisoners to write but two letters a month and one postal card weekly, but exceptions were made in urgent cases. In France at first no restrictions were placed upon the number or length of letters which prisoners were allowed to write but in consequence of the abuse of the privilege and in consequence of the German regulations the French government subsequently felt obliged to introduce certain restrictions. Prisoners in Germany were allowed to receive parcels not exceeding five kilograms in weight, and this privilege was availed of on a large scale by British and French prisoners in Germany for obtaining food from home. There were of course many complaints that letters and parcels never arrived or were detained for long periods of time in the camps before being distributed. There were also the usual complaints in regard to rigorous discipline, especially in the German camps and many charges were made of cruel and harsh treatment and the American representatives found these charges to be well founded in some camps. There was considerable demand in England for the adoption of retaliatory measures against German prisoners in consequence of the alleged mistreatment of British prisoners in Germany, but no such measures appear to have ever been adopted. There was also considerable demand that the commanders and crews of submarines who were guilty of sinking British merchant vessels should when captured be denied the treatment accorded to prisoners of war, but the British government declined to adopt such a policy. It did, however, introduce a policy of differential treatment in regard to such prisoners by seggregating them from other prisoners, but otherwise they were treated the same. This policy aroused intense indignation in Germany and in consequence of the threat of the German government to retaliate in kind, the British government abandoned its policy of differential treatment. It is somewhat singular that considering the unprecedented number of prisoners held by most of the belligerent governments no serious efforts appear to have been made looking toward a general system of exchange or releases on parole. At the outset the French government adopted the practice of releasing German officers on parole but it was subsequently abandoned in consequence of the refusal of the German government to accord reciprocity of treatment. Arrangements were concluded between the principal European belligerents for the reciprocal repatriation of interned civilian prisoners of non-military age (see Enemy Alien Problems) and in the year 1916 an agreement was reached between Germany on the one side and Great Britain and France on the other for the transfer to Switzerland of all wounded prisoners held by each government, as well as all prisoners who were suffering from any one of 20 specified diseases or infirmities. In pursuance of these agreements many thousand wounded and incapacitated prisoners were transferred to Switzerland, where although still held as prisoners they enjoyed the privilege of living in a neutral and friendly country. Shortly before the close of the war an arrangement was concluded for the reciprocal repatriation of prisoners who had been in captivity as long as 18 months. The number of such prisoners thus repatriated or transferred to neutral countries was, however, a very small proportion of the total number held by the various belligerent governments.

Bibliography.—'American Rules of Land Warfare' (ch. 4); Bordwell, 'Law of War' (Pt. II, ch. 4); Cohen, 'The Ruheleben Prison Camp'; Gerard, 'My Four Years in Germany'; Lawrence, 'Principles of International Law' (Sec. 164); Mahoney, 'Sixteen Months in Four German Prisons'; McCarthy, 'The Prisoner of War in Germany'; Oppenheim, 'International Law' (Vol. II, Secs. 125–132); Spaight, 'War Rights in Land Warfare' (Ch. 10).

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PRISONS. A prison is a place of confinement or of involuntary restraint for the safe custody of criminals and others committed by process of law. There are detention prisons for persons awaiting trial and confinement; prisons for those convicted and sentenced to imprisonment. The former are sometimes called jails and the latter are frequently called penitentiaries or workhouses or houses of correction or reformatories. See Reformatories.

Workhouses and houses of correction are supposed to be used for the older and for petty offenders while reformatories are for those capable of learning a trade or of receiving an education in a school. Confinement prisons and penitentiaries are generally thought of as places for the imprisonment of more hardened or serious offenders, where the discipline is supposed to be firmer and more arbitrary. In actual practice, however, the statutes and sentences to imprisonment do not recognize clearly these distinctions.

Detention prisons came into general use before confinement prisons and penitentiaries, as the former were needed for those whose cases had not been disposed of by the courts, whereas those convicted were, until the latter part of the 18th century, frequently put to death or branded or mutilated and let go, or were deported beyond the seas. Only in certain exceptional cases were the guilty held in custody in surroundings which were always unpleasant and provided with coarse fare and rough lodgings and required to engage in irksome labor. Only one workhouse or house of correction was built in London up to 1550 and a workhouse was established in Amsterdam in 1588. In Lubeck and Bremen there was no institution of this type until 1663. Berne in 1615, Hamburg in 1620, Basle in 1667, Vienna and Breslau in 1670, Luneburg in 1676, Florence in 1677 and Munich in 1687 were among the other European cities to establish and build one such institution, respectively.

The shocking picture of English prisons given us by John Howard during the latter part of the 18th century forced people to think about prisons and awakened the public conscience on both sides of the Atlantic to indescribable evils, particularly the evils of the English detention prisons, and enabled Howard to force a change in England's treatment of offenders. Howard made people see that these prisons were

> "Pestiferous dens, overcrowded, dark, foully dirty; not only ill-ventilated, but deprived altogether of fresh air. The wretched inmates were dependent for food upon the caprice of their gaolers or the charity of the benevolent; water was denied them in the scantiest proportions; their only bedding was putrid straw. Every one in durance, whether tried or untried, was heavily ironed, all alike were subject to the rapacity of their gaolers and the extortions of their fellows. . . . Idleness, drunkenness, vicious intercourse, sickness, starvation, squalor, cruelty, chains, awful oppression and every culpable neglect — in these words may be summed up the state of the gaols of the time of Howard's visitation."

Hundred of these wretches were debtors, guilty only of breaches of financial rules. Hundreds more of them had been committed under legal fictions. The poor father of a family, often shiftless and unfortunate, was locked up only to be joined by his wife and children, who were made penniless by his confinement. Though innocent before the law, yet these unfortunates remained in jail without trial and without redress.

Howard's recommendation that penitentiaries or confinement prisons be established finally bore fruit in the erection of Milbank Prison in England, which was begun in 1813 and partly completed by 1816. However, Newgate in London still remained a public den of iniquity in 1817 when Elizabeth Fry began her remarkable visitations and ministrations to the crazed creatures confined there.

Howard's work in England was paralleled by a similar movement in America, led by the Philadelphia Quakers. To relieve the horrible suffering in the city jail or prison of Philadelphia, these Quakers formed in 1776 The Philadelphia Society for Assisting Distressed Prisoners, but their activities were terminated by the British occupation of the city in the Revolutionary War. Immediately after the close of the war the leading citizens of Philadelphia began a successful agitation for the reform of the barbarous colonial Penal Code. In 1787 the Philadelphia Quakers and others interested in prison reform founded The Philadelphia Society for Alleviating the Miseries of Public Prisons. This society still exists as the leading force in Pennsylvania prison reform, its name having been changed to that of the Pennsylvania Prison Society in 1887. It is, thus, the oldest prison reform society in Europe or America. Its activities were most effective in bettering prison conditions in Pennsylvania. It aided in the reformation of the Criminal Code, introduced preaching into the Walnut Street Prison, devised the Pennsylvania or Separate system of prison administration and brought about a general improvement of discipline in the city prison. The work of the society extended beyond the borders of Pennsylvania. They carried on a correspondence with John Howard in England, exchanging ideas on desirable modes of prison reform and were the centre from which the reform of criminal jurisprudence and prison administration spread into other States of this country. Their success led to the establishment of similar organizations elsewhere. The London Society for the Improvement of Prison Discipline was formed in 1815; the Prison Discipline Society of Boston in 1826; the New Jersey Prison Instruction Society in 1833; and The New York Prison Association in 1845.

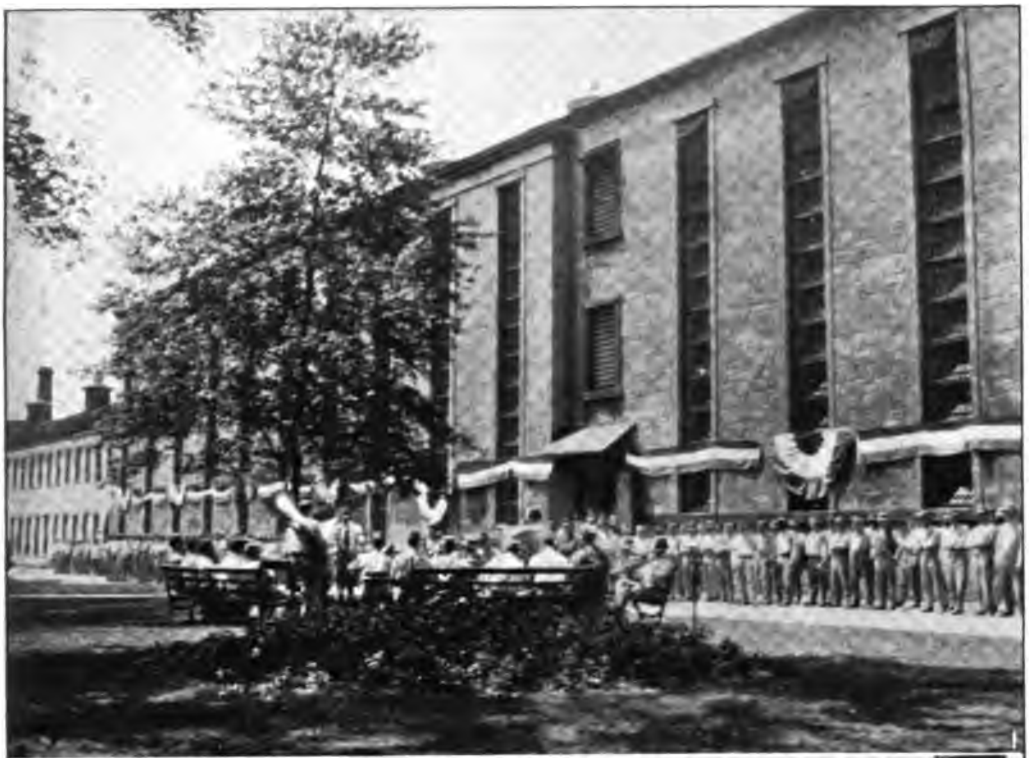
America had its own «Newgate,» originally the Simsbury Copper Mine. Abandoned as a copper mine it was used by the colony of Connecticut in 1773 as a permanent prison for Tories, and then by the State military authorities. In 1793 it was made the State prison and continued as such until 1827. Richard H. Phelps described this prison in the following language:

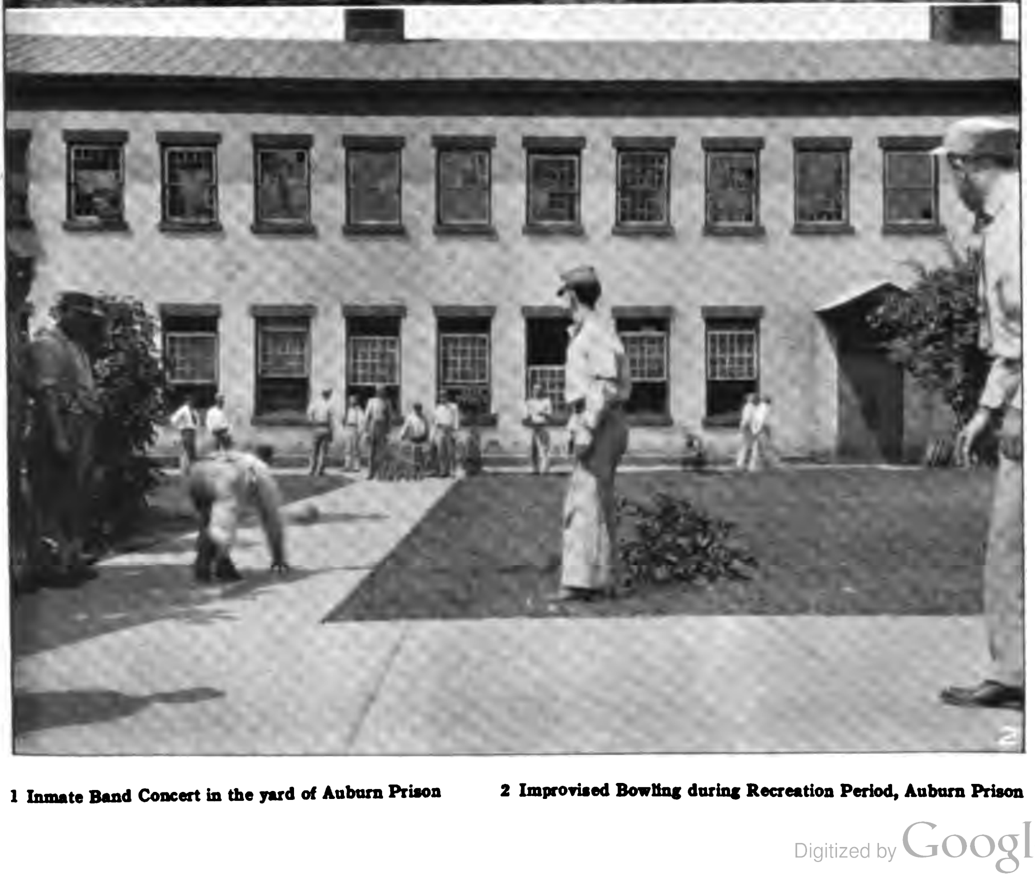
> "The appearance of this place forcibly reminds the observer of the walls, castles, and towers erected for the security of some haughty lordling of the feudal ages; while the gloomy dungeons within its walls call to remembrance a bastile or a prison of the Inquisition. Some rude buildings covering access to the caverns were constructed with an enclosure of half an acre or so built of planks with iron spikes upon the top. The passage down the shaft into the cavern was upon a ladder fastened upon one side and resting on the bottom. At the foot of this passage commences a gradual descent for a considerable distance, all around being solid rock or ore. The passages extend many rods in different directions, some of them even leading under the cellars of the dwellings of the neighborhood. . . . On the sides in the niches of the cavern, platforms were built of boards for the prisoners, on which straw was placed for their beds. The horrid gloom of this dungeon can scarcely be realized. . . . From thirty to one hundred were placed together through the night, solitary lodging as practised at Wethersfield afterwards being then regarded as a punishment rather than a blessing to them. The punishments inflicted for prison offenses were flogging, confinement in stocks in the dungeons, being fed on bread and water during the time, double or treble sets of iron, hanging by the heels, etc. A bell summoning the prisoners to work brought them up from the cavern beneath through a trap-door, in irregular numbers, two or three together, and sometimes a single one alone, when under guard of armed soldiers they were conducted across the yard to the smithy. The prisoners were heavily ironed and secured by fetters, and being therefore unable to walk, made their way by jumps and hops. On entering the smithy some went to the side of the forges, where collars dependent by iron chains from the roof were fastened around their necks, and others were chained in pairs to the wheelbarrows. The attendants delivered pickled pork to the prisoners for dinner at their forges, a piece for each thrown on the floor, and left to be washed and boiled in the water used for cooling the iron wrought at the forges. Meat was distributed in a similar manner for breakfast."

As stated, toward the close of the 18th century the Quakers of Philadelphia determined to attempt to reform the offender instead of destroying him or weakening him or mutilating his body. The agitations of John Howard and of the English reformers encouraged them in their activity. In 1796 Rev. Robert J. Turnbull visited the Philadelphia prison and commented upon the orderly condition of the prison as contrasted with public convict labor conditions then abolished. He said of the former conditions:

> "A grand and important defect, though not generally observed, appeared too plain to some of the promoters of the plan, to inspire them with sanguine expectations of its success. It was the inefficacy of the punishments of labor, mutilation, and whipping, inasmuch as they destroyed an important end of punishment, that of the criminal's reformation. . . . The convicts who were sentenced to the wheel-barrow and dispersed along the streets and roads, exhibited, from the difficulty of superintending them, the most shameful scenes of drunkenness, indelicacy, and other excesses in vice. The inconvenience and mischievous effects of the punishment of public labor at length became so intolerable that it was regarded, and with much justice, as a common nuisance."

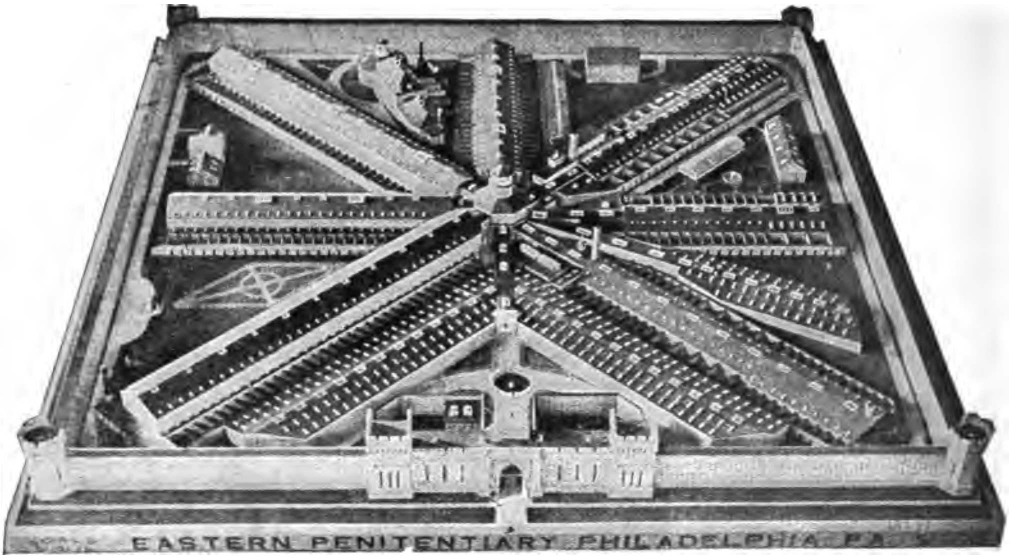
Caleb Lownes, a leader in the reform movement, thus described the effect of the improved discipline brought about following the changes introduced in 1790:

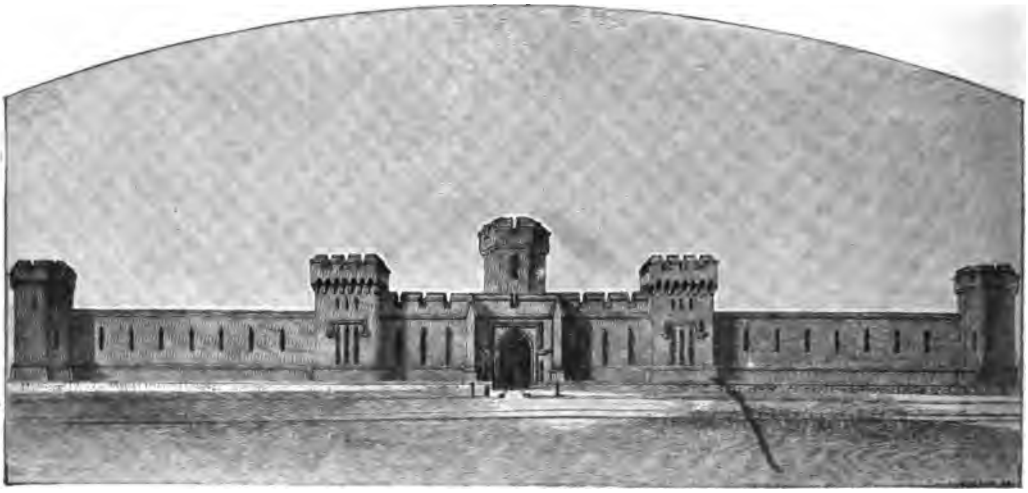




1 Inmate Band Concert in the yard of Auburn Prison

2 Improvised Bowling during Recreation Period, Auburn Prison





1 Model of the Eastern Penitentiary, Philadelphia, Penn.   2 Front Elevation Eastern Penitentiary, Philadelphia, Penn.

> "When the present plan was at last attempted, the prisoners were informed that the new system was now to be carried into full effect — that their treatment would depend upon their conduct; and that those who evidenced a disposition that would afford encouragement to the inspectors to believe that they might be restored to their liberty, should be recommended to the governor for a pardon, as soon as circumstances would admit; but if they were convicted again, the law, in its fullest rigour, would be carried into effect against them. A change of conduct was early visible. They were encouraged to labour, and a number were employed at carrying stone, and other laborious work, at the building of the solitary cells. Their good conduct was remarked. Many were pardoned, and before one year was expired, their behaviour was, almost without exception, decent, orderly, and respectful. This fact is one of importance, as it disproves an opinion, that has led to much distress and cruelty, and will, I hope, be an encouragement to those who can feel for this unhappy class of mankind, who have so long been victims to the sad effects of a contrary treatment."

The note struck at the Walnut Street Prison in Philadelphia following 1790 began a new era in prison management and treatment which revolutionized prison management all over the world so that the principle of the isolation of the prisoner in a single cell was widely adopted. This Walnut Street plan was later called the Separate or Pennsylvania System as contrasted with the Silent or Auburn System. The Separate System was actually originated contemporaneously in 1790 in the Walnut Street Prison in Philadelphia and in the county gaol at Gloucester, England, but received its full development in the construction of the Eastern Penitentiary of Pennsylvania, authorized by the legislature of that State by a law of 20 March 1821 and erected between 1821 and 1829 according to plans drawn by John Haviland. New Jersey adopted the Pennsylvania system and erected an addition to its prison which was completed in 1820.

Under the Separate or Pennsylvania System, each man was placed in a large cell of solid masonry, closed save for one small opening facing the inside corridor through which the prisoner crawled when he entered his cell, and save for a slit in the upper part of the outer wall far above his head, which provided the only natural light the poor creature had. The cell usually consisted of two rooms, one for the prisoner's bed and the other for his workroom. Each had a very high ceiling. When the heavy, massive wooden door closed over the small hole behind the prisoner who crawled into his cell; when he began his sentence, he was left in solitude to consult his Bible, his work and his own past. He never came out until he died or until his sentence expired. He was occasionally observed by his keeper through a hole in the bottom of the door, and sometimes visited by the prison chaplain. Except for this, he was left to his awful loneliness and solitude.

The Silent or Auburn System provides for the confinement of each prisoner in a single cell by night and for work in silence in a workshop by day. These cells were built of solid masonry in rows, tier upon tier and back to back, with door openings on outside corridors. These cells were in effect caverns of uniform size, high enough for a man to stand in, long enough for him to lie in and about twice as wide as his body when he lay on his back. They were called cell blocks and were enclosed in a building with massive side and end walls in which tiny windows were placed in such a position that the prisoner could never see through them to observe the sky or the earth. These side and end walls were placed far enough away from fronts of the cells and ends of the cell blocks so as to provide a wide corridor on either side of and a wide area at the ends of the cell block and were covered with a solid roof, usually without openings.

The Auburn State Prison was authorized in accordance with this plan in 1816. In 1825 Sing Sing, another New York prison of the same type, was authorized by the legislature. This type of prison architecture, with few changes, has dominated prison construction down to the present day, almost without any exception. The reasons for its continuance have been undoubtedly its flexibility, its simplicity, its low cost of supervision and maintenance and its security. Most of these prisons were furnished with dungeons or sections built like the Pennsylvania system cells except that they were usually dark and were used for the confinement in isolation of those undergoing punishment for infraction of the rules of the prison. With these exceptions, the Silent or Auburn System has predominated in America, but in Europe the Separate System has been more popular. New York allowed separate confinement in 1796, but abandoned it following 1821. Maryland introduced this system in 1809 and terminated its existence in 1838. In Massachusetts separate imprisonment was utilized to some extent from 1811 to 1829. Maine experimented with it for only three years (1824–27). New Jersey introduced it in 1820 and abandoned it in 1828, only to reintroduce it in 1836 and utilize it until 1858. Virginia accepted the Pennsylvania system in 1824 and legislated it out of existence in 1850. Rhode Island found this system a failure after a trial from 1838 to 1844. In Pennsylvania the Separate System was abandoned in the Western Penitentiary in 1869 and legally terminated in the Eastern Penitentiary in 1913, long after it had ceased to exist as a practical fact. With these more or less temporary exceptions the Auburn System was universally adopted in the prison architecture and administration of the United States.

The strongest argument in favor of the Separate or Pennsylvania System is probably that found in the report of the Eastern Pennsylvania Penitentiary inspectors to the legislature in 1830, 40 years after the establishment of the system, which reads in part as follows:

> "Intemperance and thoughtless folly are the parents of crime, and the walls of a prison are generally peopled by those who have seldom seriously reflected; hence the first object of the officers of this institution is to turn the thoughts of the convict inwards upon himself, and to teach him to think; in this, solitude is a powerful aid. Hence this mode of punishment, bearing as it does with great severity upon the hardened and impenitent felon, is eminently calculated to break down his obdurate spirit; and when that important object of penitentiary discipline has been gained (and in any prison it frequently is), and when the prisoner has once experienced the [illegible] of [illegible] principles of this institution on a [illegible] and contrite heart, he learns, and he feels, [illegible] religious reflection, relieved by industrious [illegible] trade, comf[illegible] support his mental and [illegible] divest his so[illegible] of all its horrors, and [illegible] of much of [illegible]ity. The impression [illegible]ead of being [illegible]ed by the sneers of [illegible] and fixed [illegible] officers of the prison."

Perhaps the most ardent defense of the Auburn or Silent System is the following description of this system by Louis Dwight, who did more than any other person to secure the almost universal introduction of the Auburn

System throughout the United States. Writing in 1826 he said:

> "At Auburn we have a more beautiful example still, of what may be done with proper discipline, in a prison well constructed. It is not possible to describe the pleasure, which we feel in contemplating this noble institution, after wading through the fraud and material and moral filth of many prisons. We regard it as a model worthy of the world's imitation. We do not mean that there is nothing in this institution, which admits of improvement; for there have been a few cases of unjustifiable severity of punishment; but, on the whole, the institution is immensely elevated above the old penitentiaries. The whole establishment from the gate to the sewer, is a specimen of neatness. The unremitted industry, the entire subordination, and subdued feeling of the convicts, has probably no parallel among an equal number of convicts. In their solitary cells they spend the night with no other book but the Bible. From one end of the shops to the other, it is the testimony of many witnesses, that they have passed more than 300 convicts, without seeing one leave his work or turn his head to gaze at them. There is the most perfect attention to business from morning till night, interrupted only by the time necessary to dine. Under these circumstances they are provided with the word of God, by a law of the state which requires that every cell shall be supplied with a Bible or Testament. They also receive the undivided attention of a most wise and faithful religious teacher, who spends all his time in the prison visiting the sick; teaching those who cannot read; preaching in the chapel on the Sabbath the unsearchable riches of Christ; and afterwards in going from cell to cell, to administer the reproof and consolation of religion, to individuals. The influence of the chaplain, according to the testimony of all the officers, is most salutary and powerful; and the various expressions of confidence and affection exhibited towards him by the convicts, is most cheering to himself. It is hardly necessary to add that at Auburn there is an exclusion of all the positive evils of the old system, which arise from crowded night rooms, evil communication, instruction in all the arts of pick pockets, thieves, incendiaries, and counterfeiters; and, above all from the existence of a crime, which is not fit to be named among Christians. These great ends are gained, partly by discipline and partly by construction."

Captain Basil Hall of the English royal navy visted America in 1827 and observed these two systems in operation, which he described in the following language:

> "The Auburn plan . . . consists in the strictest solitary confinement at night — in hard labor, but in rigid silence, by day, and always in company, though under constant superintendence; in solitary meals, under lock and key; in regulated marchings to and from their workshops; in subjecting the prisoners to stripes for infractions of the prison rules, and in their never being placed in absolute solitary confinement, except as a punishment of a temporary nature; in having prayers morning and evening said regularly by a resident clergyman, with whom alone the prisoners are allowed to converse, and that only on Sundays.
>
> "The Philadelphia plan is widely different from this. It is intended that the prisoners shall be subjected, during the day as well as night, to separate confinement, either in solitary idleness or in solitary labour; along with which they are to be allowed no more exercise than what they may themselves choose to take in their little courts. The keeper is the only person, besides the clergyman, who is ever to see them, and a Bible is to be placed in each cell. By these means it is expected that, while many of the prisoners will be reformed, a salutary terror will be spread over the evil spirits of the State, and crime will thus be doubly prevented."

The captain in condemning the Philadelphia System said:

> "As far as I have been able to learn, all the experiments which have been tried in America on solitary confinement have proved its inefficiency for any purpose of reformation; while there is abundant reason to suppose that in very many cases — I believe a majority — it leads to insanity or to suicide. It is difficult, indeed, to see how any good can spring out of compulsory idleness in prison, when the whole analogy of external life proves it to be the parent of every mischief. It o[illegible]ways to be borne in mind, also, that it is no part of [illegible]t of prison discipline to torture the prisoners, mere[illegible] punishment for his offenses independently of its e[illegible]n example to society. Neither, of course, should a ja[illegible] be made a place of amusement. It ought certainly to be rendered exceedingly irksome to the culprit; but, as far as he is concerned, its discipline, bodily and mental, should not be more severe than will make him fully sensible to the folly of his past ways. In order to accomplish this at the least expense of permanent human suffering, the criminal should, if possible, be so treated that when he gets out again, and starts afresh in the world, he should be less inclined to do mischief than he was before. The only serious doubt is, whether there is much chance of amendment taking place in a vicious and ill-regulated mind, if left to commune exclusively with its own thoughts, in solitude, with or without labour, but deprived of every ray of cheerfulness to lend efficiency and confidence to virtuous resolutions. The occasional visits of the clergyman may certainly relieve the fearful misery of absolute solitude; but unless the prisoner's mind be more or less habitually enlivened, even these lessons will fall on a soil unprepared to give them efficacy."

Charles Dickens, the novelist, who visited America in 1843, was shocked by the Eastern Pennsylvania Penitentiary, which he described in his 'American Notes' as follows:

> "Standing at the central point, and looking down these dreary passages, the dull repose and quiet that prevails is awful. Occasionally there is a drowsy sound from some lone weaver's shuttle, or some shoemaker's last, but it is stifled by the thick walls and heavy dungeon door, and only serves to make the general stillness more profound. Over the head and face of every prisoner who comes into this dark, melancholy house a black hood is drawn; and in this dark shroud, an emblem of the curtain dropped between him and the living world, he is lead to the cell, from which he never comes forth until his whole term of imprisonment has expired. He never hears of wife or children; home or friends; the life or death of any single creature. He sees the prison officers, but with that exception he never looks upon a human countenance or hears a human voice. He is a man buried alive, to be dug out in the slow round of years; and in the meantime dead to everything but torturing anxieties and horrible despair. . . .
>
> "Every cell has double doors; the outer of sturdy oak, the other of grated iron, wherein there is a trap through which his food is handed. He has a Bible, a slate and a pencil, and under certain restrictions, has sometimes other books, provided for the purpose, and pen and ink and paper. His razor, plate and can, and basin hang upon the wall or shine upon the little shelf. Fresh water is let on in every cell, and he can draw it at his pleasure. During the day his bedstead turns up against the wall and leaves more space for him to work in. His loom or bench, or wheel is there and there he labours, sleeps and wakes, and counts the seasons as they change and grow old."

William Crawford (who had investigated American prisons in 1832) and Whitworth Russell, prison inspectors of the Home District of London, were sent to America in 1837 to report upon these two systems. They disagreed entirely with the Archives of Hall and Dickens. They felt that the ease of communication between prisoners under the Silent or Auburn System was a grievous source of contamination which was inherent in that system. They recommended the Pennsylvania or Separate System for use in England, because they believed the Separate System of confinement would compensate for the necessary mistakes of the law and the requirements of economy in classifying and in housing prisoners, and also because they erroneously believed it advisable or possible for human beings to be housed under the same roof without communicating with one another. Fortunately, however, their recommendations were never carried out, for the attention of the people of England and of Europe was then directed for a time to the problem of prison administration and away from plans of prison construction.

The men who advocated the separate systems were without a true conception of social living, social control and social growth. They had no proper conception of how dependent man is upon his ability to imitate the good in others if he is to grow and develop. Deprived of the opportunity to imitate others, he shrivels and shrinks up and cannot grow out of delinquency into moral health and stability. The evils which Crawford and Russell saw in the Silent or Auburn System are inherent and in the Separate System also. The remedy for these lies in classification of offenders, and in the erection of special hospitals, schools and prisons for each class or group. Within each such institution the prisoners must be split up into groups and governed in accordance with the needs of each such group. See PENOLOGY.

Both the Separate and Silent Systems presuppose prison government which is autocratic or despotic in form. Transportation of prisoners overseas to Australia and Tasmania greatly changed and differentiated the methods of housing and governing them. Upon their arrival there they were usually placed in close confinement for a time, under some modification of the Separate or Silent System. Then during the next period they were permitted to associate at work under modifications of these systems, and finally were given a "Ticket of Leave," permitting them to go beyond the boundaries of the so-called prison to engage in work under more or less supervision.

The fact that they could be allowed to go beyond the confines of prison to engage in work reacted profoundly upon the management of the prisons and led Capt. Alexander Maconochie, who was the superintendent of the English prisons, to establish in Tasmania, then known as Van Dieman's Land, a new method of prison management, which has modified English prison methods to a considerable degree since that time. He originated the plan, which he outlined to the transportation committee of the House of Commons in London in 1837, of rewarding men for service performed by the grant of marks or credits which should take the place of money as a pecuniary reward for work performed and would secure for them a more speedy release.

Captain Maconochie's system, applied after 1840 in Van Dieman's Land, was modified and extended by Sir Walter Crofton, director of Irish prisons, following 1853. This system, as developed by Crofton and known as the Irish System, may be described as follows:

> "The period of cellular incarceration was served at Mountjoy, where there was a prison in two departments, one for men and one for women. The second stage was that of 'progressive classification,' a phrase of which he was the author. His male prisoners were transferred from Mountjoy to Spike Island, where they were divided into five classes: the probation class, third, second, and first classes, and the advanced class. The probation class could be skipped by prisoners who had made a good record at Mountjoy. The majority of those transferred were placed in the third class, where they had to earn nine marks per month for six months, or 54 marks in all, as the condition of promotion. The number of marks to be earned in the second class was the same; and in the first class twice as many, so that they could not pass from the first to the advanced class in less than one year. Under the English system they would then have been entitled to a ticket of leave; but Sir Walter would not grant it until after a test had been applied, in a condition of comparative freedom at a third prison, called an intermediate prison, at Lusk, where they slept in movable iron huts and were occupied almost precisely as freemen would have been, in farming and manufacturing. The prison at Lusk had neither bars, bolts, nor walls. Its aim was to make practical proof of the prisoner's reformation, his power of self-control, his ability to resist temptation, and to train him for a considerable period — never less than six months — under natural conditions, and so to prepare him for full freedom by the enjoyment of partial freedom as a preliminary step."

The Irish Prison System was first introduced into America at Elmira Reformatory in 1876 by Superintendent Zebulon Brockway, aided by Gaylord Hubbell, E. C. Wines, Frank Sanborn and Theodore Dwight. Therefore, in America the Irish System was called the Elmira System, and applied chiefly to young first offenders. The Elmira Reformatory building was constructed on the Auburn plan, but the rigor of silence was relaxed in the schoolrooms and to a certain extent in the shops and in the administration of the military system which Mr. Brockway introduced later on in the management of the institution. A modified marking and grading system was substituted for the definite sentence. The schoolroom and military drill were thus the American developments of the Irish Prison System. Later this enterprising superintendent borrowed therapeutic baths from the insane hospital, which he substituted for the dungeon and the club.

The Irish prison plan was also recommended for State prisons by former Warden Gaylord B. Hubbell of Sing Sing Prison, who visited the Irish and English convict prisons and made a report thereon, to the New York Prison Association, in 1865. In this report Hubbell said:

> "Let a farm of two or three hundred acres be purchased (no matter if it is cheap, rough land) situated on the line of the Erie Railroad at some point where building materials and provisions can be procured at the lowest rates. This done, I would procure plans and drawings of the best prisons in this country and in England. Having selected a plan combining the advantages of both, I would erect a new prison, having three distinct divisions, near to one another and on the same farm. The first division should have a capacity of not more than 100 cells and should be arranged for separate confinement only. The second division should have a capacity of 200 cells and should be arranged with suitable workshops, in which to employ 200 convicts, who should work in association during the day and be separated by night. The third division should have dormitories to accommodate 100 to 150 men. In the first division, the prisoners, being kept in solitude, would, of course, take their meals in the cells. In the second division a comfortable dining-hall should be prepared. In the third division all the arrangements should be such as to give as much freedom as possible to the inmates.
>
> "All prisoners sent to the proposed system should, under proper restrictions, be allowed to work their way out; but it should be clearly understood that no prisoner can ever have this advantage more than once. Those who are convicted a second time, after being subjected to this training, should go to some other prison to serve out the whole of their sentence, without any chance or prospect whatever of release or pardon."

The plan thus recommended for a New York State prison was never carried out, but in 1913 and 1914 the State legislature and the government of the city of New York authorized the construction of the New York City Reformatory at New Hampton, N. Y., situated on the main line of the Erie Railroad, 55 miles from New York City. This institution is being constructed much in accordance with the plan outlined by Hubbell, with such modifications of the original system as 53 years of prison and reformatory management have indicated are necessary.

After the development of the Irish prison system and when transportation of prisoners came to an end, certain modifications were made in British prison management. This, as modified, was made to provide three distinct periods or stages of confinement; that of probation endured in separate confinement at a so-called "close" prison; a period of labor in association at a public works prison, and conditional leave for the unexpired portion of the sentence upon parole or "ticket of leave."

During the first period a prisoner was supposed to be confined under autocratic government in accordance with Silent or Auburn System, as modified by certain features of the Separate or Pennsylvania System. In the second or intermediate period the prisoner was allowed a little more freedom and to associate in work with his fellows, while in the third period he was allowed to go beyond the walls of the prison under more or less supervision after the original example of the grant of a «ticket of leave» in Tasmania and in Australia. His permission to be abroad might be forfeited by breaches of the law or by failure to comply with the conditions governing his permit. Out of this has grown the modern parole system.

Reformatories established in most American States prior to 1890, while direct imitations of Elmira, also copied more or less the British «intermediate» prison, which was built for the confinement of the English prisoners during the second stage. The English «Borstal» system is the English adaption of her regular prison system, which provides educational and developmental opportunities for juvenile offenders. It was also derived in part from English investigations of the Elmira System. Some reformatory institutions established in the United States between 1880 and 1900 and nearly all established since that time have been patterned, not only after Elmira, but also after American industrial and vocational schools. The New Jersey and Connecticut reformatories for young men, while modeled after Elmira, have tended toward the British intermediate prison plan.

From the beginning of the 20th century public opinion has been concerned with the shortcomings of prison administration, which investigation has shown to be due in no small part to the antiquated and unserviceable type of building construction which the Silent or Auburn System provided. The form prevents proper classification, and adequate classification must always be regarded as one of the fundamental bases of prison administration. Notwithstanding this fundamental defect in construction, commendable efforts have been made to infuse a new spirit into the administration of these prisons. These attempts to build up a new type of administration in the old type of prisons have but emphasized the fact that adequate classification of prisoners is not entirely possible without the provision of different types or kinds of prisons. Modern penologists now demand that the modern prison system should never place men and women in separate parts of the same prison, and should provide:

1. Sufficient detention prisons for those awaiting trial.
2. Classification or reception prisons where all offenders are committed by the courts immediately after conviction to be observed and classified.
3. Educational, industrial and training school prisons for younger offenders.
4. Industrial prisons, preferably of the farm colony type.
5. Hospital prisons for the criminal insane and for border-line insanity cases.
6. Custodial prisons for the low grade feeble-minded, for other abnormals and for habitual offenders.

A study of prisons constructed recently or at present under construction indicates that prison architecture has broken away from its slavish copying of the Silent or Auburn Systems. Prisons for juveniles, for the insane, for petty offenders, for crippled offenders, for the high grade feeble-minded, for diseased prisoners and for all but the low grade feeble-minded and perverts and habitual offenders, are now frequently designed more like industrial schools, hospitals and labor settlements than like the old bastile of the Auburn type. Small units built in accordance with modern adaptations of the Auburn plan are still serviceable as prisons for the perverted and the hardened offenders.

A very notable development of prison administration has taken place in the Philippines since American occupation. Of particular significance is its development of vocational and industrial training in the Bilibid Prison at Manila, of agricultural colonies and also of the Iwahig Penal Settlement, where prisoners are permitted to live in houses which they are permitted to purchase from their earnings as prisoners. Upon their release they are in turn permitted to sell to the prisoners who have been given the opportunity of serving as part of their sentence at this very remarkable colony. Every division of the prison system in the Philippines aims to do its part in reforming the offender and reclaiming him from a life of evil by fitting him for his return to society. Insofar as it accomplishes this, each unit of that system and the system as a whole is performing the services required of a modern prison.

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PRISONS, Military. See Military Prisons.

PRISREND, prēs-rĕnd′, or **PRIZREN,** prēs-ren′, Jugoslavia, a former town of European Turkey and capital of the vilayet of Kossovo, on the right bank of the Rieka, four or five miles from its confluence with the Driu. By the Treaty of Bucharest (25 July 1913), which brought a temporary peace to the Balkan states after three wars, and the agreements for the rectification of the Serbian-Bulgarian and Serbian-Montenegrin frontiers, Serbia obtained, among other territorial gains, 9,973 square miles of the Turkish region formerly known as Kossovo. Here the Serbians created the administrative department of Prisrend, with its capital at the town of the same name. In the early part of the World War this entire region and the adjacent ones in Bosnia, Albania, Montenegro and Bulgaria were the scene of intense fighting. Under the World Peace Treaty of 1919 Prisrend was included in the territory of the new republic of Jugoslavia. The town, under Turkish rule, was the residence of a pasha, and the seat of a Greek metropolitan and a Catholic bishop. Among its buildings were 42 mosques, one Catholic and five Greek churches. It had considerable manufacturing interests, and a large trade with the adjacent country and beyond its borders. Pop. (1915 estimates), department, 227,425; town, 21,244.

PRITCHARD, prich'ard, **Jeter Connelly**, American jurist: b. Jonesboro, Tenn., 12 July 1857. He entered a printing office in early life, removed to Bakersville, N. C., in 1873, and until 1887 was joint editor and owner of the *Roan Mountain Republican*. He served in the State legislature in 1884, 1886 and 1890. In 1887 he was admitted to the bar and engaged in law practice in Marshall, N. C., was president of the State Protective Tariff League in 1891, delegate-at-large to the Republican National Convention in 1892, served as United States senator to fill a vacancy in 1894–97 and in the latter year was re-elected for the term of six years. In 1903 he became an associate justice of the Supreme Court of the District of Columbia; in 1904–11 was United States circuit judge of the 4th circuit; in 1912 became judge of the United States Circuit Court of Appeals.

PRITCHETT, prich'ĕt, **Henry Smith**, American astronomer and educator: b. Fayette, Mo., 16 April 1857. He was graduated from Pritchett College, Glasgow, Mo., in 1875 and later studied astronomy under Asaph Hall in the United States Naval Observatory where he became assistant astronomer in 1878. In 1880 he accepted the position of directing astronomer at Morrison Observatory, Glasgow, Mo., and in 1881 was appointed to the chair of astronomy and mathematics at Washington University, Saint Louis, Mo. He was permitted leave of absence in 1882 in order that he might observe the transit of Venus at Auckland, and he also made pendulum observations at Auckland, Sydney, Singapore and Hongkong. He was in Europe on scientific work in 1894–95, was appointed superintendent of the United States Coast and Geodetic Survey in 1897, in 1900 president of the Massachusetts Institute of Technology and in 1906 president of the Carnegie Foundation. Fourteen colleges and universities honored him with the degrees of A.B., Ph.D., LL.D. and Sc.D.

PRIVAT-DOCENT, prē-vät' dō-tsĕnt', in the German university system (and others modeled on it), an instructor whose lectures rank with those of the professor, but who unlike them has no standing in the faculty as a governing body of the university. He receives no fees except directly from his pupils. He must have received the doctoral degree and also be habilitated, that is, successfully defended a thesis, the result of his own research. The post is commonly a means of preparation for university professorship. Many distinguished men, Kant among others, have held the post as a stepping-stone to higher university rank.

PRIVATE BANKERS. See BANKS AND BANKING — PRIVATE BANKS.

PRIVATE BILLS. See BILLS, PRIVATE.

PRIVATE CORPORATIONS. See CORPORATIONS, LEGAL.

PRIVATE SAVINGS BANKS. See BANKS AND BANKING — WORLD'S SYSTEMS, PRIVATE BANKS — BANK ORGANIZATION AND MANAGEMENT.

PRIVATE SCHOOLS, institutions under private control as distinct from public, and implying maintenance by private corporations or individuals. But the school may be private, or not public, in its origin and government, and if there are no limitations as to who may be admitted as pupils, it is usually classed as a public school. In the United States private schools embrace a large number of institutions ranging in purpose from elementary to professional education. Thus in the school-year 1915–16 there were reported 1,665,075 pupils in private elementary schools of kindergarten, primary and grammar grades; 155,135 students in private high schools; 6,958 students in private normal schools, and 57,540 students in the various professional schools. More than one-half of the private schools were under the control of religious denominations and had 103,829 students of high school grade. The ordinary professional schools comprised those of theology, law, medicine, dentistry, pharmacy, veterinary medicine and nurse training, the latter in general being connected with large hospitals. In specialized work there were over 1,300 independent commercial and business schools and 762 private high schools giving business courses. These courses included stenography, typewriting, telegraphy, telephony, accountancy and general office service. Soon after the outbreak of the World War in 1914 many large financial institutions, chambers of commerce, boards of trade and colleges and universities established special schools of commerce in preparation for an expected expansion of the foreign trade of the United States after the close of the war, and a larger private specialization of educational effort was developed by the necessities of the government, especially after the United States entered the war. See RUGBY; EDUCATION, AGRICULTURAL, SECONDARY SCHOOLS.

PRIVATEER, the name applied in time of war to a ship owned by a private individual, which under government permission, expressed by a letter of marque, makes war on the shipping of a hostile power. To make war on an enemy without this commission, or on the shipping of a nation not specified in it, is piracy.

Privateering was abolished by mutual agreement among European nations, except Spain, by the Declaration of Paris in 1856; but the United States of America refused to sign the treaty, except on condition that all private property at sea, not contraband, should be exempt from capture. This «Marcy,» or «American,» amendment, as it was called, was not accepted. This doctrine was again affirmed by the United States delegates to the Peace Conference at The Hague in 1898, but was again rejected by the European powers. It is doubtful, however, how far the abolition of privateering would stand in a general war, for it is the natural resource of a nation whose regular navy is too weak to make head against the maritime power of the enemy, especially when the latter offers the temptation of a wealthy commerce. It was usual for the country on whose behalf the privateers carried on war to take security for their duty respecting the rights of neutrals and allies, and their observing generally the law of nations. In the wars of 1793–1814 many English privateers were afloat. But in the same period no less than 10,871 English ships, with over $5,000,000,000, were taken by French «corsairs»; the Breton privateer *Surcouf* took, in two months of 1807, prizes worth $1,456,250. At the American Revolution the new republic fully realized the advantage of its position in preying on the mercantile marine of Great Britain; and in the War of 1812 British commerce suffered severely at the hands of American privateers, of which it was computed that some 250 were afloat. During the American Civil War the Confederate States offered letters of marque to persons of all countries, but no admittedly foreign vessels were so commissioned. During the same period the Congress of the United States empowered the President to grant commissions to privateers, but none such were granted. The Confederate cruisers were at first regarded in the North as mere pirates; and the «Alabama Claims» originated in the charge against Great Britain of allowing the departure of privateers from British ports, where they were fitted out illegally.

The European War produced a new form of privateering, armed with torpedoes, guns and floating mines. The operations of such craft were confined for a while to enemy coast objectives and the waters of adjacent «barred zones»; but the voyage of the German commercial submarine *Deutschland* from Kiel, Germany, to Baltimore, Md., a distance of 4,180 miles, in 1916, and her safe return to Kiel, showed a startling menace to the world's shipping. It demonstrated that the new kind of under-sea craft could cruise in safety a long distance from a home base. The greatest feat of the U-boat type, up to that time, occurred in May and June 1918, when a number of such craft sank many vessels off the Atlantic coast of the United States.

PRIVET, a genus (*Ligustrum*) of shrubs or trees of the order *Oleaceæ*. About 35 species are known, natives of eastern Asia, Australia, with one of the Mediterranean region. They are deciduous or evergreen and bear terminal panicles of small, whitish, generally fragrant flowers, followed by usually black berries which often remain on the plants during winter. They are justly popular plants in shrubberies and some are widely used as hedges since they are erect-growing and stand shearing well. They are readily propagated by means of cuttings, seeds or layers, and will succeed in almost any soil, in full sun, on dry land and under partial shade. The common privet (*L. vulgare*), *L. ibota* and *L. ciliatum* are fully hardy in the Northern States, but the so-called California privet (*L. ovalifolium*), a Japanese species, is doubtfully hardy farther north than New York City. The common privet has half-evergreen, smooth, lanceolate leaves and berries about the size of peas, black, rarely white, yellow or green. The flowers have a strong and sweetish odor; the leaves, mildly astringent, were formerly used in medicine; the berries, which hang on the shrub during winter, have a disagreeable taste, but are food for many kinds of birds, and supply a pink pigment used in map-making and in dyeing. The wood of some of the larger kinds is very hard and is used for making shoe-pegs and for turning. The only insect that is commonly troublesome upon the plants is the privet web-worm (*Diaphania quadristigmalis*).

PRIVILEGE taken in its active sense is a particular law, or a particular disposition of a law, granting certain special prerogatives to some person contrary to the common right. Examples of privilege may be found in all systems of law, as in the case of members of Congress and of the several legislatures when in attendance at their legislative duties; parties as witnesses while attending court, and coming to and returning from the same, electors while going or returning to the election, are all privileged from arrest except for treason, felony or breach of the peace. Privileges from arrest are either general and absolute, or limited as to time or place.

Ambassadors and their servants are absolutely so privileged.

A privilege of arrest for a legislature member is limited to the period of the legislative session and a reasonable time in going and returning.

In the civil law a privilege is a right which the nature of a debt gives to a creditor, entitling him to be preferred before other creditors.

Privileged communications are those statements made by a client to his counsellor or attorney in confidence, relating to some cause or action then pending; such communications cannot be disclosed without the consent of the client. The courts sometimes exclude from evidence, as privileged communications, matters of a judicial, political or professional nature on the grounds of public policy.

In many jurisdictions a writ of privilege or protection is issued by the courts, affording one, under proper circumstances, protection against arrest or from the service of civil process.

A witness is entitled to the privilege of refusing to answer incriminating questions.

A physician cannot be compelled to disclose the secrets of the sick room; a Roman Catholic priest to make confessions public; a clergyman to reveal the confidences of his pastoral relations; or a juror to repeat the considerations of the jury room.

Of ancient and mediæval legislation, the Privilege formed an important branch; in truth, the condition of the so-called «privileged classes» was different socially, civilly and religiously, from that of the non-privileged. In canon law, there were two privileges pertaining to the clergy, the *privilegium canonis* and the *privilegium fori*. By the former, the person of the clergyman, of whatever degree, was protected from violence by the penalty of excommunication against the offender; by the latter, known in England as the "benefit of clergy," the clergyman was exempted from the ordinary civil tribunals, and could be tried only in the ecclesiastical courts. Most of the purely civil privileges have been abolished throughout Europe by modern legislation.

PRIVILEGED COMMUNICATIONS, statements made by a client to his counsellor or attorney in confidence, relating to some cause or action then pending; such communications cannot be disclosed without the consent of the client; the statements of a patient to his physician, of a husband to his wife, of a man or woman to a spiritual adviser, in fact communications or statements between parties placed in a confidential relation one to another are privileged in the sense that one of the parties to such will not be allowed against the objection of the other to testify with reference thereto in a court of justice. Another class of statements which enjoy a measure of privilege are defamatory statements which do not give the injured person a right of action. The statements of legislators, judges, and in some cases of litigants, their counsel, witnesses, etc., come under this class. In the United States, however, it is held generally that such statements render their authors liable to a civil action when made in bad faith and with malicious intent. The privilege, therefore, is conditional rather than absolute. Conditional privilege is also extended to defamatory statements made by a person in the discharge of his duty, whether the latter be public or private. As example of the latter is the information given by an employer to another employer about a person who has been in his employ. If bad faith and malice are proven in such cases the employer giving such information is liable to action. Consult Hageman, 'Privileged Action' (Somerville, N. J., 1899) and McLaughlin and Hart 'Encyclopedia of American Government' (3 vols., New York 1914).

PRIVILEGES AND IMMUNITIES, are those privileges of citizens of each State, in the several States of the North American Union which may not be abridged by State or local laws. The Constitution of the United States, article IV, section 2, paragraph 1, provides that "the citizens of each State shall be entitled to all privileges and immunities of citizens in the several States." By the Fourteenth Amendment (section 1), it is provided that "no state shall make or enforce any law which shall abridge the privileges or immunities of citizens of the United States, nor shall any state deprive any person of life, liberty, or property without due process of law, nor deny to any person within its jurisdiction the equal protection of the laws." What are the privileges and immunities of the citizens in the several States thus guaranteed? At the outset it may be noticed that personal liberty, the corner-stone of a republican government, is forever placed on a secure foundation by Amendment Thirteen, which declares that "neither slavery nor involuntary servitude, except as a punishment for crime, whereof the party shall have been duly convicted, shall exist within the United States, nor any place subject to their jurisdiction." The imprisonment of duly convicted criminals is not in conflict with this section, nor is the letting of them out for hire to contractors. By Amendment Four, the principle of the English common law that "every man's house is his castle" is adopted in the words "the right of the people to be secure in their persons, houses, papers, and effects against unreasonable searches and seizures shall not be violated." This provision against unreasonable searches and seizures permits in civil and criminal cases searches and seizures in cases expressly authorized by law. Resistance to an illegal seizure is permitted, but no more force is allowed in repelling an intrusion than is under the circumstances absolutely necessary. By Amendment Two, "no soldier shall in time of peace be quartered in any house without the consent of the owner, nor in time of war, but in a manner to be prescribed by law." To secure the citizen against unjust criminal accusations, and to provide him with a proper trial when accused, the Constitution contains a number of safeguards; thus, by section 9, paragraph 2, the privilege of the writ of *habeas corpus* is not to be suspended, unless the public safety in cases of rebellion or invasion, requires. By article III, paragraph 3, jury trial is guaranteed for all crimes except cases of impeachment, and the furthermost important provision is made that such trial is to be had in the State where the crime has been committed, but when not committed within any State, the trial is to be had at such places as Congress may by law have directed. It has been held that the accused is not entitled to a jury trial in the case of petty crimes and misdemeanors, but only in the case of graver crimes, where at common law the accused was entitled to a jury trial. As additional precautions in criminal trials, Amendment Five provides that no person is to be held to answer for a capital or otherwise infamous crime, unless on a presentment or indictment of a grand jury, except in cases occurring in the army or navy; or in the militia during war or in time of public danger. This amendment also provides that a person shall not be put in jeopardy of life or limb twice for the same offense, nor be compelled in any criminal case to be a witness against himself; nor be deprived of life, liberty or property without due process of law. Article VI guarantees a speedy and public trial by an impartial jury and with the assistance of counsel for his defense. Excessive bail, excessive fines, cruel and unusual punishments, all are forbidden by article VIII. Recent legislation, redolent of a period long since passed, shows that the fight of the citizens to safeguard these elementary and hard-won privileges must be never-ending, illustrating again the maxim that "Eternal vigilance is the price of liberty." (See EVIDENCE; LIBEL; INTERNATIONAL LAW; WITNESS). Consult Cooley, T. M., 'Principles of Constitutional Law in the United States' (3d ed., Boston 1898).

PRIVY COUNCIL, in England, the body of advisers of the sovereign which formally sanctions those acts of government not properly the province of Parliament. Privy councillors are nominated, without patent or grant, at the pleasure of the Crown, excepting certain persons appointed ex officio. They hold office for life, or for the life of the sovereign, so that at the accession of a new sovereign the council must be — nominally at least — reconstituted. The number of privy councillors is not limited by law.

Jurisdiction.— The duty of the council, in general, is to advise the king on affairs of state. The Lord President of the Council is required by statute "to manage the debates in Council, to propose matters from the sovereign at the Council Table, and to report to the sovereign the resolution of the Council thereon." This function, however, is largely theoretical, as there are in fact no debates in council, this body merely giving formal sanction to orders in council, by which the king, on the advice of his ministers, expresses his pleasure with respect to various administrative matters, as for instance the bringing of treaties into effect, grants of charters, the government of colonies and the regulating of departmental business. So, too, the Privy Council performs certain ceremonial functions. For instance, in council a bishop does homage for the temporalities of his see, a minister takes the oath of office and the sheriffs for counties are chosen. The council has, besides, important duties of an administrative or judicial nature which it performs by committee or commission. Several of these committees have only a theoretical connection with the council, acting to all intents and purposes independently. The Cabinet itself, the executive of the United Kingdom, is such a committee, composed of ministers belonging to the Privy Council, but it has completely outgrown the parent body in political importance, having practically superseded it in the functions which this formerly performed. The Board of Trade, now under its own president and regarded as a distinct department of state, was from the first a committee of the Privy Council. The Local Government Board of Agriculture and the Board of Education are similar developments from the council, while the universities committee, the committee "for the consideration of charters of incorporation under the Municipal Corporations Act" of 1882 are still subordinate to the main body. The judicial functions of the Privy Council are carried on by its judicial committee, which includes the Lord Chancellor and the four Lords of Appeal in Ordinary. It is concerned chiefly with appeals from the dominions and colonial and Indian courts, has ecclesiastical jurisdiction and decides concerning petitions for extension of letters patent, copyright, etc. The Privy Council is summoned on a notice of 44 hours. Only on very extraordinary occasions is there a full attendance, the presence of six members being sufficient to constitute a council. Privy councillors have the title of "right honorable" and rank immediately after Knights of the Garter. The premiers of the self-governing colonies are called to the Privy Council.

History.—The Privy Council developed out of the *curia regis* (king's council) of the Norman period, which exercised judicial legislative and administrative functions. Out of the *curia* grew the courts of law and equity and the houses of Parliament besides the Privy Council. After the time of Edward I appeared the *concilium ordinarium*, or ordinary council of the king, which in the 15th century gained the name Privy Council. The Select Council, ultimately the Cabinet, began to emerge from the larger body about the same time. In the time of Edward III the Privy Council was occasionally merged in one assembly with the House of Lords, and in 1640 the Long Parliament reduced the powers of the council. In 1679 Sir William Temple made an unsuccessful attempt to reorganize it, but since then it has dwindled into insignificance when compared with its early authoritative position, and its governmental duties have been assumed by the Cabinet. Ireland has a separate Privy Council. Bodies, somewhat similar and bearing the same name, formerly existed in several of the American colonies and States. Consult Macqueen, 'Appellate Jurisdiction of the Privy Council' (1842); Finlason, 'The Judicial Committee of the Privy Council' (1878); Dicey, 'The Privy Council' (new ed., 1887); Gneist, 'History of the English Constitution' (1891); Anson, 'Law and Custom of the Constitution' (1892).

PRIVY-PURSE, Keeper of the, an officer of the royal household in England, in charge of the payment of the private expenses, including charities, of the sovereign. He has no control over any official or household expenses, and is independent of the great officers of the household.

PRIVY-SEAL (*privatum sigillum*), a British governmental seal formerly appended by the sovereign to such grant or documents as were afterward to pass the great seal; and sometimes used in matters of less consequence, which did not require to pass the great seal, as to discharge a recognizance, debt, etc. No writ, however, which related to the common law could pass the privy-seal. From the time of Henry VIII until the reign of Queen Victoria the privy-seal was the warrant of the legality of grants from the Crown, and the authority for the Lord Chancellor to affix the great seal. Such grants were termed letters patent. The officer who had the custody of the privy-seal was anciently called clerk of the privy-seal, afterward guardian *del* privy-seal; and later Lord Privy-Seal. The Lord Privy-Seal could not put the seal to any grant without good warrant; nor with warrant if it was against the law or inconvenient without first acquainting the sovereign therewith. In 1884 the Great Seal Act stipulated that all documents required to pass the great seal need not be passed under the privy-seal, a warrant under the sign manual countersigned by the Lord Chancellor, Secretary of State or a high treasury official being sufficient. Although without salary and no definite duties, the title of Lord Privy-Seal, with its former rank as fifth great officer of the state and a seat in the Cabinet, is conferred usually upon a peer above the rank of baron, although a commoner may receive the honorary title.

PRIX DE ROME, prē dė rōm (French "prizes of Rome"), awards made by the French government to art students which entitled the winners to advanced courses of studies at l'École or l'Académie de France in Rome.

The institution was founded by Louis XIV, in 1666, at the suggestion of Colbert and was enlarged by Napoleon. Its object is to complete the education of promising students in all branches of art, by study of the classics in Rome. Those eligible for the prizes are painters, sculptors, architects, musicians and engravers, and the privilege bestowed consists of an annual income of 4,000 francs for four years and exemption from military service. Candidates must be Frenchmen between the ages of 15 and 30, and must have done certain work at the Ecole des Beaux Arts or elsewhere. The competition is so arranged as to comprise only 10 students from each department for the final competition, and these are allowed three months in which to accomplish the work they put in for the prize. While studying at Rome the successful competitor is expected to send to the Salon, or if he be a musician to the Conservatoire, every year, specimens of the work he is engaged in, and thus report progress.

PRIZE, property taken from an enemy in war; that which is seized by fighting, especially a ship, with the goods contained in her; any description of goods or property seized by force as spoil or plunder. The law as to prizes taken at sea is regulated by international law. In order to vest the title of the prize in the captors it must be brought with due care into some convenient port for adjudication by a competent court. In the United States, the court of naval jurisdiction is the Federal District Court, from which cases may be removed under certain conditions to the Circuit Court, or for final adjudgment to the Supreme Court. In Great Britain, the subject of prizes, captures, condemnation, etc., are vested exclusively in the Admiralty Division of the High Court of Justice. (See ADMIRALTY LAW; PRIZE-MONEY). Consult Barclay, T., 'Law and Usage of War' (Boston 1914).

PRIZE COURTS AND PRIZE JURISDICTION. As a general rule when enemy property is captured at sea under circumstances that render it liable to appropriation and confiscation by the captor the rights of the original owner are extinguished. But it may be that there is doubt as to whether the property is really enemy-owned, or whether it was captured in waters where warlike operations may be lawfully carried on, or whether it was not immune from capture by reason of its being in a neutral vessel, and the like. It is now a well-established rule of the law of nations that in all such cases the right of the captor to the property in question ought to be made the subject of adjudication by a court. It is generally admitted that the captor may destroy by sinking or otherwise an enemy prize when there is no doubt as to its character and ownership, and when for lack of a sufficient coal supply or inability to spare a prize crew he cannot take the prize in to a home port for adjudication by a prize court, or when the taking of it in would expose the captor to the danger of destruction or his prize to liability to recapture. The right of destruction in such cases was generally exercised by Confederate naval commanders during the American Civil War, and it has been exercised on a large scale by German naval commanders during the present war. In both cases the home ports of the captor were blockaded by the enemy and since neutral ports are not open to a belligerent for the sequestration of his prizes the captors had no other alternative than to destroy their prizes. But as to the right to destroy *neutral* prizes without submitting the question of the legality of the capture to a prize court for adjudication, the law and practice of the past is otherwise. Most text-writers on international law maintain that in such cases a captor has no right of destruction. German naval commanders during the recent World War, however, acted on the contrary assumption and made no distinction between enemy prizes and neutral prizes, and whenever possible destroyed both alike without taking them in for adjudication by the courts. Sir Edward Grey recently stated the customary rule when he said "Great Britain has always maintained that the right to destroy is confined to *enemy* vessels only, and this view is favored by other powers." Concerning the right to destroy *neutral* vessels, the view hitherto taken by the greater naval powers has been that, in the event of its being impossible to bring in a vessel for adjudication she must be released. The prize courts of Great Britain for more than two centuries have held this to be a rule of the law of nations and there appears to be no instance during the wars of the 19th century in which a captor deliberately destroyed a neutral prize instead of taking it in for adjudication by a prize court.

The institution of prize courts for the determination of the legality of captures at sea is, however, of modern origin. Prior to the 16th century there does not appear to have been any such institution as a prize tribunal. When, therefore, a capture was made at sea the captor determined for himself by a summary inspection of the ship's papers and an examination of the persons on board whether the vessel or its cargo should be confiscated as lawful prize or allowed to proceed. The only remedy of the owner in such cases was to petition the king for redress. By a British order in council issued in 1585 it was decreed that henceforth all prizes should be brought in for adjudication. Ultimately it became the practice in all countries in time of war to set up tribunals for the purpose of deciding upon the validity of captures made by their cruisers at sea. These tribunals came to be known as prize courts. In England jurisdiction in all matters of prize was conferred upon the High Court of Admiralty by virtue of a special commission issued by the Crown at the outbreak of war, and by the Naval Prize Act of 1864 the Court of Admiralty was constituted a permanent court of prize, independent of any commission issued under the great seal. More recently the High Court of Justice was substituted for the Court of Admiralty as a permanent prize court and its jurisdiction is actually exercised by the Probate, Admiralty and Divorce Division. During the Napoleonic wars the prize court of England was made famous by the decisions of Lord Stowell. During the Crimean War the court was presided over by Dr. Lushington and during the World War it was held by Sir Samuel Evans. Special commissions to decide questions of prize were also issued to various courts in the overseas dominions and the colonies, for example at Alexandria, Malta, Ottawa and other places. Appeals may be taken to the judicial committee of the Privy Council. In the United States the Federal District Courts have original jurisdiction in prize cases but claimants may take appeals to the Supreme Court. In France the prize jurisdiction is exercised by a Council of Prizes consisting of five members. In Germany there were during the World War two prize courts, one located at Hamburg, the other at Kiel, each held by five judges. Cases could be appealed to the Supreme Court of Prize at Berlin, composed of seven judges. Prize courts are municipal tribunals although the law which they apply is international law and the rights which they are called upon to adjudicate are in most cases those asserted by the citizens or subjects of foreign states. They are, in short, practically judges in their own cases and are exposed to the temptation, to the bias and prejudice which may be expected of courts in deciding issues between their own government and foreign claimants. Added to this defect is the absence of an international code of prize law and the consequent divergences of view regarding the rules to be applied. To remove these defects the second Hague Conference in 1907 adopted a convention providing for the establishment of an international prize court, and the International Naval Conference at London in 1909 formulated a code of prize law dealing with such matters as blockade, contraband, the destruction of prizes, transfer of flag, unneutral service and the like. The international prize court was to be composed of 15 judges and upon the court the eight principal maritime powers were to be always represented. From the decisions of national prize courts appeals might be taken to the international tribunal, which it was believed would be more likely to decide the questions submitted to it with less bias and prejudice than could be expected of national courts. Unfortunately, however, owing to differences of opinion among the nations in regard to the constitution of the court it has never been organized, and in consequence of the failure of the powers to ratify the Declaration of London (q.v.) there is as yet no international prize code binding upon the national tribunals. Some states like Germany and France have put into effect prize codes of their own. The United States government issued such a code in 1900 but five years later it was revoked by President Roosevelt (see LAWS OF WAR, THE). Great Britain issued a manual of naval prize law in 1888 but it has since been withdrawn. British prize law is now found mainly in the Naval Prize Act of 1864, the Prize Courts Act of 1894 and various orders in council issued thereunder. The remainder consists of custom and judicial precedent. All authorities are in agreement that although prize courts are municipal tribunals the law which they must apply is international law, but as stated above there are wide divergencies of opinions to what that law is in respect to many questions, and the failure to ratify the Declaration of London leaves the prize courts of each nation free to interpret the customary law according to their own notions and apply such rules as they consider to have become well established. The view that prize courts are bound to apply the law of nations was affirmed by Lord Stowell in the case of the *Maria* as long ago as 1799 and the early commissions issued to the Court of Admiralty required that it should "hear and determine according to the course of admiralty and the law of nations." As late as the year 1916 the judicial committee of the Privy Council in the case of the *Zamora* laid down this principle. "The law which the prize court is to administer," it said, "is not the national law, or, as it is sometimes called, the municipal law, but the law of nations; in other words international law."

But suppose the municipal law of a state is contrary to international law. Must the prize court give effect to the former or the latter? The question was presented to Lord Stowell in 1811 in the case of the *Fox* and he disposed of it rather unsatisfactorily by saying that the court would assume that an order in council of the king which was believed to be contrary to the rules of international law was in accord with international law and that the court could not "without extreme indecency" presume the existence of a conflict. The issue was again raised in England during the World War in the case of the *Zamora* which involved the question as to whether an order of the king in council contrary to the established rule of international law was binding upon the prize court, and upon appeal to the judicial committee of the Privy Council it was held that such an order was not binding. The Privy Council admitted that if an act of Parliament contrary to international law were passed it would be binding upon the prize court, but orders in council stood on a different footing and they were not so binding when in conflict with international law. The idea that the king in council could prescribe or alter the law to be administered by the prize court, it said, was out of harmony with the principles of the British Constitution. The Supreme Court of the United States has long held to the same rule, that is to say, the courts are bound by municipal statutes even when they are contrary to international law, although they are not bound by executive orders which are in conflict with the established principles of international law.

The procedure of a prize court is in the nature of an inquest upon the property which has been placed within its custody, for the purpose of discovering whether it has been lawfully captured and whether it was liable to capture. The proceedings begin by the action of a representative of the captor government in libelling the property, that is, by petitioning the court to hold an inquiry. He submits with the petition the ship's papers, affidavits and other documents which contain evidence of the liability of the ship or cargo to capture and of the lawfulness of the capture. Notice is then given to the claimant in order that he may come forward and assert whatever rights he may have in the property libelled. Ordinarily enemy claimants are not allowed to appear but during the World War the president of the British prize court made an exception in the case of enemy claimants who asserted any right, title or interest under any of The Hague conventions. All such persons were permitted to appear by counsel and assert freely their rights, in spite of their enemy character. Prior to the American Civil War it was considered to be an established rule of prize procedure that the evidence must come in the first instance from the ship's papers and the depositions of the officers and crew of the vessel. Ordinarily extrinsic evidence could not be adduced by the captor. During that war, however, it was found impossible to adhere strictly to the old rule, especially in cases of continuous voyages where it was necessary to prove the actual intention of the shipper. In theory the burden of proof lies upon the captor, but generally in practice it is upon the claimant, and property brought in by the captor rarely escapes condemnation unless the owner can prove that it was not liable to capture. If the character of the evidence referred to above, technically known as evidence «in preparatory,» is deemed sufficient by the court, it renders its decision. If not, what is styled «further proof» is called for and the proceedings take on more of the character of an ordinary judicial trial between litigants.

The British prize court rules of 1914 introduced an important change in the established procedure by allowing cases to be decided in the first instance upon «such further evidence, if any, as might be admitted by the judge.» Under this rule each side was free at the outset, as in an ordinary civil or criminal action, to establish his case by any and all evidence that it could produce. The United States government complained of this new rule and asserted that it was a well-established and long-settled practice to consider at the first hearing only the ship's papers and documents and that the introduction of additional evidence could not be allowed except upon an order of the court for «further proof» and then only after the case had been fully heard upon the facts already in evidence. In short, under the new rule there was no longer a «first hearing» on the evidence derived from the ship and the prize court was no longer precluded from receiving extrinsic evidence from any and every source. To this criticism the British government replied that modern conditions had rendered the old rule obsolete and in any case the practice and procedure of prize courts were not regulated by international law but were determined by each nation for itself. Finally, the procedure referred to in the American note of protest had never been followed by the prize courts of France or any other Continental country; it was not, therefore, international law. The decree of the prize court is usually that the ship or goods or both shall be condemned or released. In the case of enemy ships found in port at the outbreak of war, if not liable to condemnation, decrees detaining them until the end of the war are issued. A large number of such decrees were issued by the British prize court during the World War. Except during the first days of the war there were few captures at sea. Most of the ships which were made the object of prize proceedings were seized in port at the beginning of the war and decrees of detention rather than of condemnation were issued. German merchant vessels encountered on the high seas proceeding to and from British ports, in ignorance of the outbreak of hostilities, however, were condemned by the prize court, in consequence of Germany's failure to ratify the article of The Hague Convention which exempted such vessels from capture.

When a decree of condemnation is issued the vessel in some countries, e.g., France, is condemned to the captors who divide the proceeds of the prize among them. This was the practice in Great Britain until the outbreak of the World War when the rules relating to bounties were altered. The captors no longer receive the prize but the court awards a bounty of £5 to each person actually present or taking part in the capture or destruction of the ships. In 1898 bounties for captures at sea were abolished by an act of Congress. It has always been the British practice to award compensation to neutral merchants by condemning the captor in damages and costs when the latter fails to make out a case against a prize brought in for carrying contraband and there was no good ground for the seizure. But this practice has not been followed on the Continent.

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PRIZE-FIGHTING, fighting with the fists for a reward or prize. The ancient Greeks were the earliest to have prize-fights among their sports, so far as our historic knowledge goes. The *pugilatus* (prize-fighter) fought naked except, at times, for a loin cloth. The sport was so popular that the nation placed gods and heroes among the victors in the *ring*, among them Apollo, Heracles, Tydeus, Polydeuces. It was considered one of the hardest and most dangerous games and death during or soon after the encounter was common. They used the *cæstus*, made of thongs or strips of leather which were tied around the fighters' hands to make the impact of a blow more telling. Later the *cæstus* was loaded with lead and iron, producing frightful weapons. First recorded statements of professional prize pugilism as a popular sport in England date from the end of the 17th century, and the championship started with James Figg of London, who held the title from 1719 to 1730. He built an «amphitheatre» where, as «Master of Ye Noble Science of Defence» (as his printed circular reads), he taught the nobility and gentry «ye use of ye small back sword and quarter-staff at home and abroad.» His encounter with Ned Sutton, in 1727, started with a broadsword bout, after which they took up their unarmed encounter, which was as much a wrestle as a fist-fight. In 1733 a Venetian, «The Gondolier,» fought Bob Whitaker, who appears to have given the Italian a *solar plexus* blow in the last round. His victory was soon followed by his defeat in a true fisticuff encounter with Nathaniel Peartree. Both these British fighters were pupils of Figg, as were also Tom Pipes and George Gretting who fought each other — none challenging the champion Figg. Pipes beat Gretting. In 1734 George Taylor (on Figg's death) claimed the championship, the reason not being quite clear, but none disputed the claim. Jack Broughton became the third champion and introduced the sole bare-knuckled fight with the broadsword and other combats discarded. He also reduced the «rules» of the «ring» to a fine art. The next champion was John Slack, butcher, who beat Broughton in 1750. But the Duke of Cumberland, who had been a great and admiring patron of Broughton, and who had bet $50,000 against $5,000 on him, considered he had been swindled by a palpable fake fight, closed the old amphitheatre and set the police on the trail of the ex-champion. William Stevens, «The Nailer,» pounded the fight out of Slack, after breaking his arm; but only to hold the title some eight and one-half months. Then, from appearances, he «sold» the championship by flagrantly leaving himself open to a blow on the head from his competitor, George Meggs, which felled him, he walking off laughing «none the worse for the fray.» Meggs had to leave London on account of the scandal and was beaten by Millsom, a Bath baker, who held the title for three years. In 1765 Tom Juchau, «The Disher,» defeated Millsom, to be beaten the following year by William Darts, a dyer, at Guilford, with a stake of $5,000, the largest since the Broughton-Slack affair. Darts was knocked out, in 1769, by Lyons, the waterman, the betting 10 to 1 against the latter. Lyons retired and gave back the title to Darts who lost it to Peter Corcoran, a herculean six-foot Irishman, who held the championship till 1776, when he was beaten by Harry Sellers (13th champion) in a match for a stake of $500 and a wager of $3,000. Thomas Jackling (frequently mentioned as Tom Johnson) became 14th champion after beating a number of challengers. «Big Ben» Brain, in 1791, defeated Jackling, but died in 1794, having been a sick man for years before he won the title. Daniel Mendoza, a Jew, held the 16th title, improving the science with his skill and ending the reign of the crude slugger. Mendoza also introduced the profitable occupation of sparring exhibition tours, and built the Lyceum in the Strand, London, for teaching the «noble art.» John Jackson next became champion, in 1795. Nineteenth holder of the title was Jack Bartholomew, who was knocked out by James Belcher, grandson of the 4th champion, Slack, in his 19th year. Next came Hen Pearce («The Game Chicken») as 21st champion, with John Gully, his successor, who retired and became member of Parliament. Thomas Cribb was 23d champion, and beat the American negro (first of his race to enter the ring) Bill Richmond in 1805. Thomas Molyneaux, another American negro, after beating Burrows and Blake claimed a championship match with Cribb, but lost the fight in 1810 and again in 1811. Thomas Winter, under the alias of Spring, took the 24th championship in 1823. Tom Cannon got the title in 1824, and Jem Ward in 1825. James Burke became 27th champion in 1833, but, on his return from an American tour, he was beaten by William Thompson (*Bendigo*) in 1839. Then Ben Caunt, who had beaten Bendigo before he met Burke, was declared champion, losing the title to Nick Ward, but regaining it (as 33d champion). In 1845 Bendigo again won the title. Caunt met «The Michigan Giant,» Charles Freeman, to make an engagement, but the American's seven-foot-three height and 333 pounds of trained fighting flesh and bone caused him to take the giant to England on an exhibition tour. William Perry, «The Tipton Slasher,» became 35th champion in 1850, passing the title over to Harry Broome on a foul in 1851. Tom Paddock was champion (37th) from 1856 to 1858, when he was defeated by Tom Sayers, who became 38th champion heavyweight after having beaten all comers as middleweight till Nat Langham defeated him. Sayers held his own when 1860 brought him a contestant in the American champion, J. C. Heenan («Benecia Boy»). This noted battle in 1860 was stopped by the referee in the 42d round, Heenan blinded in both eyes and Sayers with his right arm out of commission since the seventh round. The draw was never fought out, the world's title being held jointly by both, each presented with a belt. Heenan, in 1863, was beaten by Tom King in England, he becoming the 40th champion. So England had held the championship for two centuries, losing but one battle to the Irishman, Peter Corcoran, and the draw with Heenan. Jem Mace became champion in England in January 1862, only to lose it back to Tom King in November. Heenan, returning to England as the American champion, was knocked out by King, he becoming world champion. Mace next became (1863) champion, beating Joe Goss. America sent Joe Coburn, an Irish-American, to get the belt but in 1864 he returned without a fight and claimed the championship; later in the year Joe Wormald went to England to fight for the championship but on account of an accident lost his engagement stake without a fight. Squabbles and police interference made prize-fighting in England so difficult that the sport had to be carried on in America. Here the police made the carrying out of engagements quite difficult, and in 1868 the meeting of Ned O'Baldwin, the Irishman, and Joe Wormald at Lynnfield, Mass., was broken up by the police. But Mace met Tom Allen near New Orleans in 1870, defeating Allen in 10 terrific rounds. And with Mace's retirement in 1873 we have reached the last English champion. An attempt at reviving prize-fighting in England was made 1889–90, when the engagement was made between the Australians Slavin and M'Auliffe, but the fight at Walworth was stopped and, encountering later, they were both arrested. What the old-time sports called prize-fighting, however, was killed when gloves (even if only four ounces) had to be used by professionals. The brutality of the bare-knuckled prizefights gave place to the more scientific boxing. In 1885 James Smith won the heavyweight championship of England. In 1887 he was defeated by Jake Kilrain of Boston, the latter now becoming the world's champion. John L. Sullivan, of Boston, defeated Kilrain in 1889 in what is thought to have been the last contest in America under London prize-ring rules. Sullivan remained champion until 1892 when he was defeated by James J. Corbett the cleverest boxer the world had hitherto known or perhaps will ever know. In 1897 Robert Fitzsimmons defeated Corbett, but only held the championship three years, losing it to James J. Jeffries at Coney Island, N. Y., in 1900. For eight years Jeffries defeated several aspirants for championship honors, but on

4 July 1910 was defeated at Reno, Nev., by the colored pugilist Jack Johnson. The latter lost his crown to Jess Willard at Havana, Cuba, 5 April 1915. On 4 July 1919, Willard fought Jack Dempsey at Toledo, Ohio, and was defeated in three rounds. (See BOXING). Consult 'Fistiana' (London 1868); 'American Fistiana' (New York 1876); Lynch, 'The Complete Amateur Boxer' (London 1913); Miles, 'Pugilistica' (3 vols., London 1863); O'Reilly, 'Ethics of Boxing' (Boston 1888); Doran, 'Self-Defense' (Toronto 1879); 'Boxing' (Badminton Library, London 1899); 'Boxing' (in Oval Series, ib. 1896); 'Boxing' (Spalding's Libraries, New York annually); Trotter, 'Practical Treatise on Boxing' (Philadelphia 1900).

PRIZE-MONEY, in warfare, money paid to the captors of a ship or place where booty has been obtained, the money being realized by the sale of the captured property after the established court, on full evidence, has adjudged it lawful spoil. The amount realized by the sale, placed in the hands of the official accountant of the navy, is distributed ratably, according to rank, among the officers and men who assisted at the capture. See PRIZE.

PRJEVALSKY, przhä-väl'skē, or **PREJEVALSKI**, prä-zhä-väl'skē, **Nicholas**, Russian traveler: b. Otradny, government of Smolensk, 31 March 1839; d. Karakol, West Turkestan, 1 Nov. 1888. Having joined the army in 1855 he assisted in quelling the Polish insurrection of 1861. While stationed in Siberia in 1867 he explored the Usuri region, south of the Amur, and spent 1871–73 in traveling from Peking through southern Mongolia (region of the Ordus) to the Ala-shan, Koko-nor and the upper waters of the Yang-tse-Kiang. In 1876–77 he explored Lob-nor on the borders of East Turkestan and China, and in 1879 reached a point some 160 miles north of Lhassa, when the Tibetan authorities turned him back. He reached Kiachta after a journey of nearly 15,000 miles. In 1883–84 he again crossed the desert of Gobi, but returned without being able to reach Lhassa. When the British began their war against the Tibetans in Sikkim he was placed at the head of a strong expedition, and ordered to reach Lhassa at all hazards. Already weakened by years of hardship, he was unable to endure the fatigues and exposure of another journey, and died on the route to Vernoje, where he intended to equip his expedition. Prjevalsky brought back from these journeys valuable collections of animals and plants, all now preserved at Petrograd. On his return to Petrograd from Siberia, he published a volume of 'Notes on the Ussuri.' Subsequently his accounts of his journeys were published in the 'Proceedings' of the Petrograd Geographical Society in *Petermanns Mitteilungen* and other journals.

PROA. See CATAMARAN.

PROBABILISTS, those philosophers who maintain that certainty is impossible and that we must be satisfied with what is probable. This was the doctrine of the New Academy, particularly of Arcesilaus and Carneades. The last-mentioned philosopher distinguished three principal degrees of probability, according as a representation might be probable when considered by itself alone; probable and unimpeached when compared with others; or thirdly, probable, unimpeached and in all respects confirmed. In morals probabilists are those who teach that in our actions we must follow what seems to us probably right, because in questions of morality demonstrative certainty is not to be attained. There are some Christian teachers (and among them Gury in his 'Compendium Theologiæ Moralis') who taught that a man may follow what is probably right, or what has been decided to be so by teachers of authority, although it may not be the most probably right, or may not seem probable to himself. It is this view that Pascal in his famous 'Provincial Letters' holds up to ridicule. Butler in his 'Analogy' bases his argument on probability, to which he applies the term "moral certainty." There were four schools of probabilism, known as probabilism simple, æqui-probabilism, probabiliorism and tutiorism. The first held it to be lawful to act upon any probable opinion no matter how slight its probability; the second required that the opinion should be "solidly probable," but held that, provided it be really probable, it would be lawful to act upon it, even though the conflicting opinion should be equally probable; the third, in the conflict of probable opinions, would only permit action on the more probable of the two, but it would permit this even when the less probable adverse opinion was the "more safe"; and the fourth required that in all cases the more safe opinion should be followed, even when the less safe opinion was much the more probable.

PROBABILITY, Theory of, is that branch of mathematics which deals with the determination of the degree of belief which, in the absence of full information, should be given to certain classes of statements, or to the past or future occurrences of certain events.

In regard to the great majority of events there is in the mind of every one a state of uncertainty. Under differing circumstances one shows this uncertainty by saying that it is possible or that it is, or is not, probable that some event did or will happen. Ordinarily no attempt is made to establish an exact measure of the probability of an event, such attempt being clearly foredoomed to failure. Not infrequently, however, the first step toward such a measurement is taken by the making of a rough comparison of the probabilities of two events, the conclusion resulting that one of them is *more* probable than the other.

Equally Probable Events.— For certain sorts of events it is possible to proceed farther. Thus, as a next step, it is quite common to find that two events are regarded as *equally* probable. For instance, a coin being tossed, one says that head and tail are equally likely to appear; or, a properly made die being thrown, one estimates that any one of the six faces is as likely to appear as any other. Of course these estimates are made in spite of the belief that, starting from a given initial position, the body moves completely subject to the laws of dynamics, and that from certain influences but one result can follow. The fact is that the observer is so ignorant of the forces applied to the body that his judgment is formed independently of them. He perceives that from the nature of the body only a certain number of events are possible, and he finds no reason for concluding that one event rather than another will occur.

Probability of an Event.— Suppose now that five events are known to be equally probable and that one of them will and only one can happen. Suppose also that if and only if one or another of the first three occurs, a further event E will occur. Then it is commonly said that the odds are 3 to 2 in favor of the event E; and since there are five equally probable events, of which exactly three are concurrent with E, it is said that the mathematical probability of E is $\frac{3}{5}$. In general, *when a specified event E is governed by n equally probable events, of which one will and only one can happen, and when, of m of these, each is decisively favorable to E, all others being decisively unfavorable, the mathematical probability of E is defined to be $\frac{m}{n}$.* In the extreme cases in which none and all of the events, respectively, are favorable to E, the probabilities are said to be 0 and 1, though in each case there is certainty regarding the occurrence of E.

Assume now that, of n equally probable and mutually exclusive governing events, m_1, m_2, …, m_k are respectively favorable to the further events E_1, E_2, …, E_k, which are also mutually exclusive. Then the probabilities of E_1, E_2, …, E_k are respectively $p_1 = \frac{m_1}{n}$, $p_2 = \frac{m_2}{n}$, …, $p_k = \frac{m_k}{n}$. If now $m_1 + m_2 + \ldots + m_k = n$, one has $\frac{m_1}{n} + \frac{m_2}{n} + \ldots + \frac{m_k}{n}\ 1$; or $p_1 + p_2 + \ldots + p_k = 1$. The result may be stated formally as

Theorem 1. *The sum of the methematical probabilities of a number of events, of which one must and only one can happen, is unity.*

The application of the definition requires the selection of a set of governing events, finite in number, which must be either equally probable or capable of being replaced by a set of equally probable events; it then requires a correct enumeration of the favorable events and of the whole set. Each of these steps may present difficulties, but failure follows most frequently from a wrong selection of the set of governing events. Consider the following example:

Ex. 1. *A coin being tossed twice, what is the probability that head appears twice?*—One might say that the possibilities, or governing events, are three in number, viz., the appearances of two heads, of a head and a tail, and of two tails, respectively; that of these one is favorable, and that $p = \frac{1}{3}$. But the answer is incorrect because the appearance of two heads, or two tails, is not as probable as that of a head and a tail. The following are really equally probable events: the appearance of head, head; of head, tail; of tail, head; of tail, tail. They are four in number, one being favorable. Hence $p = \frac{1}{4}$.

The solutions of the following problems illustrate the direct application of the definition. Nearly all problems in this subject require the use of the theory of permutations and combinations. See ALGEBRA, *Permutations and Combinations.*

Ex. 2. *Two dice being thrown, what is the probability that the throw will be seven?*— The equally probable events are the appearances of the several numbers of the first die with those of the second die, and are 36 in number. The favorable cases are the following sets: 1, 6; 2, 5; 3, 4; 4, 3; 5, 2; 6, 1; they are six in number. Hence $p = \frac{6}{36} = \frac{1}{6}$.

Ex. 3. *Two dice being thrown twice, what is the probability that at least one double appears?* —In either throw any face of one die may be associated with any one of the other. Hence there are 36 equally probable cases for each throw. Each case for the first throw may be associated with each case for the second throw. Hence there are $36^2 = 1,296$ cases in all. Of the 36 cases in either throw 30 will fail to yield a double. The association of each of these cases for the first throw with each of these for the second throw will yield all of the *unfavorable* cases. Hence there are $30^2 = 900$ unfavorable cases, and accordingly, $1,296 - 900 = 396$ favorable cases. Hence $p = \frac{396}{1296}$.

Ex. 4. (*a*) *From a bag containing five balls some are to be drawn. Find the probability that an even number of balls will be drawn.* (*b*) *Find also the probability if the number of balls be n.*—(*a*) The total number of cases is the sum of the numbers of ways of drawing 1, 2, 3, 4 and 5 balls, which is $5+10+10+5+1 = 31$. The numbers of ways of selecting 2 and 4 balls are 10 and 5. Hence the number of favorable cases is 15. Hence $p = \frac{15}{31} = \frac{1}{2} - \frac{1}{62}$.

(*b*) The total number of cases is

$$_nC_1 + {_nC_2} + \ldots + {_nC_n}.$$

The number of favorable cases is $_nC_2 + {_nC_4} + \ldots$ Now $(1 + 1)^n = 1 + {_nC_1} + {_nC_2} + \ldots + {_nC_n}$,

$$\text{and} \quad (1 - 1)^n = 1 - {_nC_1} + {_nC_2} \ldots .$$

Hence $2^n - 1 =$ total number of cases. Also $2^n - 2 = 2({_nC_2} + {_nC_4} + \ldots)$, and so $p = \frac{2^{n-1} - 1}{2^n - 1}$.

Notice that an odd number of balls is more likely to be drawn than an even number.

Another problem remarkable alike for its apparent difficulty, the fine reasoning employed in its solution and the simplicity of its results is the following one:

Ex. 5. *At an election two candidates A and B received respectively a and b votes, A being elected. What is the probability that during the counting of the ballots A was always ahead?*— The solution is obtained easily after it is shown that of the orders of counting which are unfavorable to the result mentioned exactly one-half begin with a vote for A. The answer is $p = \frac{a - b}{a + b}$, i.e., *the majority divided by the total vote.*

TOTAL PROBABILITY. COMPOUND PROBABILITY.

It may happen that the m governing events favorable to E can be classified into sets of m_1, m_2, …, m_k events respectively, where $m = m_1 + m_2 + \ldots + m_k$. The probability, p_1, that E will be concurrent with one of the set of m_1 events is $\frac{m_1}{n}$. Then since $\frac{m_1}{n} + \frac{m_2}{n} + \ldots + \frac{m_k}{n} = \frac{m}{n}$, one has $p_1 + p_2 + \ldots + p_k = p$. Stated formally one has

Theorem 2. *If an event can happen in several mutually exclusive ways, the probability of its happening at all is equal to the sum of the* *probabilities of its happening in the several ways.*— Here p is called the *total probability,* p_1, p_2, etc., the *partial probabilities.* On the other hand the event E whose probability is sought may consist in the concurrence of several independent events. Suppose that these events are $e_1, e_2, \ldots, e_k$, and that for them the total numbers of cases are $n_1, n_2, \ldots, n_k$, respectively, and that the numbers of favorable cases are $m_1, m_2, \ldots, m_k$, respectively. Then for the event E the total number of cases is $n_1n_2 \ldots n_k$, and of these $m_1m_2 \ldots m_k$ are favorable. Hence

$$p = \frac{m_1m_2 \ldots m_k}{n_1n_2 \ldots n_k} = \frac{m_1}{n_1}\frac{m_2}{n_2} \ldots \frac{m_k}{n_k} = p_1p_2 \ldots p_k.$$

Hence one has

Theorem 3. *The probability of the concurrence of several independent events is the product of the probabilities of their several occurrences.*— This theorem can be extended to the cases in which events, not independent, have a specified order, and in such cases the probability of each is to be computed on the hypothesis that the preceding events have happened.

These three theorems form the basis of the whole of the elementary theory. Their application will be illustrated in the solution of the following example:

Ex. 6. *A with three coins endeavors to throw more heads in one throw than B can throw with two coins. In case of a tie they throw again. What is the probability of A's winning?* —The following ways in which A can win include all cases, and are mutually exclusive. He may (1) throw 3 heads, (2) throw 2 heads and win, (3) throw 1 head and win, (4) he may tie B on the first throw and win on a subsequent throw. Let p be the total probability of A's winning, and p_1, p_2, p_3, p_4 the partial probabilities. The following table gives the chances of various throws by A and B:

Number of heads	3	2	1	0
A's chance	$\frac{1}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{1}{8}$
B's chance	0	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{4}$

Then, by theorem 3, $p_1 = \frac{1}{8}$, $p_2 = \frac{3}{8}(1-\frac{1}{4})$, $p_3 = \frac{3}{8}(1-\frac{1}{4}-\frac{1}{2})$. Also p_4 is the product of the probabilities that a tie will occur and that A will subsequently win. The probabilities that a tie will occur with 3, 2, 1, 0 heads are 0, $\frac{3}{8} \times \frac{1}{4}$, $\frac{3}{8} \times \frac{1}{2}$, $\frac{1}{8} \times \frac{1}{4}$. The sum is $\frac{5}{16}$. If a tie occurs, the initial condition is reproduced and A's chance of winning is p. Hence $p_4 = \frac{5}{16}p$. Then, by theorem 2, $p = \frac{1}{8} + \frac{9}{32} + \frac{3}{32} + \frac{5}{16}p$, whence $p = \frac{8}{11}$.

PROBABILITIES OF REPEATED EVENTS.

An interesting part of the theory is that relating to repetitions of events. Consider an event whose probability is p, and let $q = 1 - p$. Suppose that n trials are made. The probability that the n trials will result in s occurrences and $(n-s)$ failures of the event, in a specified order, is p^sq^{n-s}. But the number of different orders is $\frac{\underline{|n}}{\underline{|s}\,\underline{|n-s}}$. Hence the probability that in n trials there will be exactly s occurrences is $\frac{\underline{|n}}{\underline{|s}\,\underline{|n-s}}p^sq^{n-s}$. By considering different values of s one may find the probability that the number of occurrences shall lie between specified limits. Thus if a coin be tossed 10 times, one finds the probabilities of the appearances of exactly four, five and six heads to be $\frac{210}{1024}$, $\frac{252}{1024}$, $\frac{210}{1024}$; and the probability that the number of heads will not differ from five by more than one is $\frac{672}{1024}$ or $\frac{21}{32}$.

An easy problem is the determination of that number of occurrences which is most probable. It is necessary only to compare the results of giving to s consecutive values between zero and n to discover that for the most probable case s must be so chosen that the fraction $\frac{s}{n}$ is as nearly as possible equal to p. Hence in 10 throws, the most probable number of heads is 5 because $\frac{5}{10} = \frac{1}{2} = p$. Likewise in 73 throws with one die the most probable number of throws of aces is 12, since $p = \frac{1}{6}$, and $\frac{12}{73}$ is the fraction having the denominator 73 and being most nearly equal to $\frac{1}{6}$.

Of particular interest is the case in which the number of trials is very large. In this case the evaluation of the probability may be made approximately by the use of Stirling's formula: $n = n^{n+\frac{1}{2}}e^{-n}\sqrt{2\pi}$, where e is the Napierian base. By this means many interesting results may be derived. Thus if p_0 denote the probability of that number of occurrences which is most probable, $p_0 = \frac{1}{\sqrt{2\pi npq}}$; and if P_l denote the probability that the number of occurrences shall not deviate from the most probable number by more than l, which does not exceed a small multiple of $\sqrt{n}$, then

$$P_l = \frac{2}{\sqrt{\pi}}\int_0^\gamma e^{-t^2}dt + \frac{e^{-\gamma^2}}{\sqrt{2\pi npq}},$$

where $\gamma = \frac{l}{\sqrt{2npq}}$. The results here obtained are due to James Bernoulli, and are usually combined in a statement of what is called

Bernoulli's Theorem. If an event has a constant probability, p, and if $q = (1-p)$, then, n trials being made, the most probable result is that in which the ratio of the number of occurrences to the number of trials is most nearly equal to p. The number of trials being very great, the probability that the deviation of the number of occurrences from the most probable number shall not exceed l is

$$P_l = \frac{2}{\sqrt{\pi}}\int_0^\gamma e^{-t^2}dt + \frac{e^{-\gamma^2}}{\sqrt{2\pi npq}},$$

where $l = \gamma\sqrt{2npq}$, and l does not exceed a small multiple of $\sqrt{n}$.

For very many purposes in the Theory of Probability the definite integral $\int_0^\gamma e^{-t^2}dt$, is of great importance, and so tables of its values for different values of γ have been prepared. It may be shown, too, that a very good approximation to the value of P_l is given by the equation $P_l = \frac{2}{\sqrt{\pi}}\int_0^{\gamma'} e^{-t^2}dt$, where $\gamma' = \frac{l+\frac{1}{2}}{\sqrt{2npq}}$.

From the tabulated value of the probability integral, $\frac{2}{\sqrt{\pi}}\int_0^{\gamma'} e^{-t^2}dt$, the following facts regarding Pl become evident. *First*, the deviation l being specified, the values of γ' and of Pl decrease rapidly as n increases. In fact if the number of trials be increased sufficiently, the probability that the specified deviation will not be exceeded can be made smaller than any fraction assigned in advance. *Second*, if γ' and hence Pl be specified, the corresponding deviation l increases rapidly as n increases, but the relative deviation, or the ratio of the deviation to the number of trials, decreases rapidly.

To illustrate these statements let it be recalled that, a coin being tossed 10 times, the most probable result is five heads and five tails, and the probability that the deviation of the number of heads (from five) should not exceed one was found to be $\frac{21}{32}$. Consider now the cases of 10,000 and 10,000,000 trials. A careless examination might suggest that for the same probability, $\frac{21}{32}$, the corresponding deviations would be 1,000 and 1,000,000 respectively. As a matter of fact, simple computations show that they are not more than 50 and 1,500 respectively.

The very close relation which existed between the theory of probability and the study of games of chance makes it exceedingly interesting to see what conclusions can be drawn regarding the probable results of persistent gambling. Bernoulli's theorem applies directly. Since the conclusions for all cases are similar it will be most satisfactory to consider a simple one.

Suppose, then, that A, with a capital of $1,000, repeatedly bets $10 evenly that the toss of a coin will yield head. The game seems fair, and it might appear that in the long run A would neither win nor lose. Notice, however, that A will be ruined whenever he shall have lost 100 times more than he has won. The theory shows that of all possible cases the most probable is that in which the numbers of heads and tails are equal. But the probability of the result is $\sqrt{\frac{2}{\pi n}}$, and it evidently decreases rapidly as n increases. Bernoulli's theorem shows that, if the number of trials be about 25,000, the probability that the deviation shall exceed 100 is about $\frac{2}{10}$. Hence the chance that A will neither win nor lose the amount of his present fortune soon becomes inconsiderable. One may say, then, that in the long run A will either be ruined or will at least double his fortune; and the chances of these events appear to be even. As a matter of fact A is at a serious disadvantage. For many runs of results which might ultimately be favorable to him are excluded because in their beginnings he has so many losses that he must cease play for lack of money. On the other hand all runs which began favorably but ultimately become unfavorable must be counted because A does not stop as long as he wins. Hence the equality of the chances is destroyed.

MATHEMATICAL EXPECTATION.

A person who has a possibility of securing without cost a property of any sort places upon that possibility a value which depends upon that of the property and upon the probability of his securing it. In our subject a definite valuation is placed upon such a possibility. This valuation is called its *mathematical expectation* and is defined to be *the product of the value of the property and the probability of getting it.* More generally, if there are several gains, a_1, $a_2, \ldots, a_n$, with the respective probabilities, p_1, $p_2 \ldots, p_n$, the mathematical expectation arising from these gains is $E = p_1a_1 + p_2a_2 + \ldots + p_na_n$. In this connection losses may be treated as negative gains. It is not denied that such an estimate involves the disregard of many elements, but unquestionably in the applications of this definition which are generally made such disregard is reasonable. To be more specific, it is extremely unlikely that a poor man would regard a possible gain of $2,000, whose probability is $\frac{1}{2}$, as equivalent to the actual possession of $1,000. On the other hand such an estimate is made the basis of all insurance business and is justified by the results obtained.

The connection between mathematical expectation and gambling is evident. If a person throws a die and is to receive $600 in case an ace appears, his expectation is $600 × $\frac{1}{6}$ = $100. Unquestionably $100 would be regarded as a fair entrance-fee to one who could afford to repeat the trial a number of times. In this connection the condition under which a game is said to be *fair* may be mentioned. Suppose that a player has to pay a stake b to enter a game in which his chance of winning a sum a is p. Then for a fair game $b = pa$, or his expectation after his entry must be equal to his stake.

The derivation from the definition of mathematical expectation of certain results which seemed to him to be impossible of acceptance led Daniel Bernoulli to develop a theory of *moral expectation* which has received some considerable attention. Bernoulli laid down the principle that to the possessor of a fortune a the *moral value*, v, of a small gain h is directly proportional to the amount of the increase, and inversely to this present fortune; or that $v = k\frac{h}{a}$ (where k is a constant); and that if the probability of this gain is p, the moral expectation arising from it is $pv = \frac{pkh}{a}$. The results obtained from this estimate differ widely from those obtained under the preceding one. They do, however, become less widely divergent from the latter as a increases, and in fact as a increases indefinitely the two sets of results tend to a perfect agreement.

PROBABILITIES DERIVED FROM EXPERIENCE.

Probabilities of Causes.— Hitherto the determination of the probability of an event has been based directly or indirectly upon certain governing events. A problem of another sort comes up for consideration. In the discussion of this problem and similar ones the word *cause* will be given an unusual meaning. For the present purposes the term will be used to mean a set of circumstances which might have given rise to an event. The problem may be stated as follows:

It is known that an event E has happened, and it is known that one of several causes has given rise to the occurrence of E; it is required to determine the probability that E arose from a specified one of the causes.

A concrete example is furnished by the following problem.

Ex. 7. *Two bags contain respectively one white and one black ball, and one white ball and nine black ones. A ball has been drawn from one of the bags, has been observed to be white and has been replaced. What is the probability that it was drawn from the first bag?* — Let p be the required probability. There are two ways of computing the probability of drawing a white ball from the first bag. In the first place it is necessary that the first bag should be selected and that, it having been selected, a white ball should be drawn. This gives $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$ as a result. In the second place it is necessary that a white ball should be drawn and that, having been drawn, it should have come from the first bag. This yields $(\frac{1}{2}\cdot\frac{1}{2} + \frac{1}{2}\cdot\frac{1}{10})p$. Hence, equating these values one gets $p = \frac{5}{6}$.

Similar reasoning applied to the general case yields the following result:

Theorem 4. *If an event E has occurred as a result of one or another of certain causes* $C_1, C_2, \ldots, C_n$, *whose respective probabilities previous to the occurrence of E were* $\pi_1, \pi_2, \ldots, \pi_n$, *and if, when any one of the causes, as* C_i, *is known to be operating, the probability that it will produce E is* p_i, *then the probability,* P_i, *that E resulted from* C_i *is*

$$P_i = \frac{p_i\pi_i}{p_1\pi_1 + p_2\pi_2 + \ldots + p_n\pi_n}.$$

Apply the result to the following example:

Ex. 8. *From a bag containing five balls, each of which is either white or black, four drawings have been made, the ball being replaced after each drawing. The result is three white balls and one black one. What are the probabilities that the bag contains* (1) *four white, one black ball,* (2) *three white, two black,* (3) *two white, three black,* (4) *one white, four black?* — There are four causes: (1) Four white, one black, (2) three white, two black, etc., and before the drawing they were equally probable. Hence $\pi_1 = \pi_2 = \pi_3 = \pi_4 = \frac{1}{4}$. Also $p_1 = (\frac{4}{5})^3\,\frac{1}{5}$, $p_2 = (\frac{3}{5})^3\,\frac{2}{5}$, $p_3 = (\frac{2}{5})^3\,\frac{3}{5}$, $p_4 = (\frac{1}{5})^3\,\frac{4}{5}$. Then $P_1 = \frac{64}{146}$: $P_2 = \frac{54}{146}$, $P_3 = \frac{24}{146}$, $P_4 = \frac{4}{146}$.

When the number of causes is very great the formula of theorem 4 becomes unwieldy. It is found that a simpler formula gives an approximate result. The method used in deriving this formula will be illustrated in the following example:

Ex. 9. *From among an exceedingly great number, N, of balls, each of which is either black or white, n balls are drawn, each ball being replaced before the next drawing. Of these exactly s are white. What are the probabilities for the various possible numbers of white and black balls in the whole set?* — Since before the drawings nothing was known as to the desired result, the a priori probabilities for all numbers of white balls from 0 to N are equal. Now the total number of white balls will be known if the ratio, r, of that number to N be known. Hence equally probable values of this ratio are all proper fractions having N as denominator. Since N is very great, r varies from 0 to 1 by very small increments. *It will now be assumed* that for purposes of approximation r may be treated as varying continuously from 0 to 1. Also, if r is the correct ratio, the probability that in n drawings s white and $(n - s)$ black balls would appear is

$\frac{\underline{|n}}{\underline{|s}\,\underline{|n-s}}\, r^s(1-r)^{n-s}$. If r varies continuously from 0 to 1, the probability of any specified value of r is zero, but the a posteriori probability that the ratio shall lie between r and $r + dr$ is

$$p_r = \frac{r^s(1-r)^{n-s}dr}{\int_0^1 r^s(1-r)^{n-s}dr} = \frac{\underline{|n+1}}{\underline{|s}\,\underline{|n-s}}\, r^s(1-r)^{n-s}dr,$$

since the number of values of $r^s(1-r)^{n-s}$ as r varies from r to $r + dr$ is measured (see *Geometrical Probability*) by dr; and the probability that r shall lie between r_1 and r_2 is

$$P = \frac{\underline{|n+1}}{\underline{|s}\,\underline{|n-s}} \int_{r_1}^{r_2} r^s(1-r)^{n-s}dr.$$

A general theorem might be formulated embodying this result, and such a theorem jointly with theorem 4 would constitute what is called the Theorem of Bayes.

The maximum value (see CALCULUS, INFINITESIMAL, *Maxima and Minima*) of $r^s(1-r)^{n-s}$ is obtained by putting $r = \frac{s}{n}$, and is $\frac{s^s(n-s)^{n-s}}{n^n}$.

Then the most probable cause is that in which the actual ratio of the number of white balls to the total number is the same as the corresponding ratio in the observed results.

A discussion of the value of P, which must be omitted, yields the following notable result:

Theorem 5. *The probability that, under the conditions of example 9, the ratio of the number of white balls to the total number shall not deviate from its most probable value,* $\frac{s}{n}$, *by more than* $\gamma\sqrt{\frac{2s(n-s)}{n^3}}$ *is* $\frac{2}{\sqrt{\pi}}\int_0^{\gamma} e^{-t^2}dt.$

Empirical Probabilities.— The preceding theory finds application in connection with any sets of events which for the purposes of any discussion may justly be compared with the drawing of balls from a bag. In some of the important connections this theory is in fact indispensable. It will be noted that in both of the examples 8 and 9 the inquiry was in regard to the probability of the various possible numbers of white and black balls. But if the ratio of the number of white balls to the total number of balls be known, that ratio furnishes the probability that a further single drawing will produce a white ball; and in general this probability is what is most urgently sought. Probabilities estimated in this way from observed events are called *empirical probabilities.*

Two methods of deriving empirical probabilities are used, one theoretically correct, but leading to troublesome computations, the other avowedly approximate only. The latter method involves the assumption that, of the possible causes of the observed event, that which has the greatest a posteriori probability is the true one. These two methods will be applied to example 8.

Suppose that after the drawing of the balls from the bag the question be asked, «What now is the probability of drawing a white ball?» By the second method the answer would be obtained as follows: The most probable state of the bag is that it contains one black and four white balls. Hence the probability of drawing a white ball is $\frac{4}{5}$.

The following is the other method of treatment: The probability that the bag contains four white balls and one black one and that a white one will be drawn from it is $\frac{64}{146} \times \frac{4}{5}$; that it contains three white and two black and that a white one will be drawn is $\frac{54}{146} \times \frac{3}{5}$; that it contains two white and three black and that a white one will be drawn is $\frac{24}{146} \times \frac{2}{5}$; and that it contains one white and four black, and that a white one will be drawn is $\frac{4}{146} \times \frac{1}{5}$. Hence the probability that a white ball will be drawn is $\frac{47}{73}$.

Where the number of causes is greater the difference between the two values is smaller, and theorem 5 shows that when the number is very great the difference can be very small indeed, as it becomes nearly certain that the ratio r differs by very little from $\frac{s}{n}$.

GEOMETRICAL PROBABILITY.

In what precedes it has been assumed except in one case that the number of equally probable events governing the event E is finite. The definition may be extended to include the case in which the number of events is infinite provided appropriate measures for the totalities of cases can be devised. Such measures are available when each case corresponds to a set of values or one or more continuous variables. Problems requiring the adoption of such measures are generally geometrical, and hence this branch of the subject is called *geometrical probability*. Merely an indication of its nature may be given by one or two very elementary examples.

Although the number of points on any line segment cannot be counted, yet their totality may be measured by the length of the segment. Similarly the totality of points in an area may be measured by that area; and so on. The probability that, all values being equally probable, a number less than unity is also less than one-half is ½ because the totality of cases is measured by a unit segment, and that of the favorable cases by half a unit segment. Similarly, if all points within a circle of radius a are equally likely to be selected, the probability that one of them selected, at random, is not distant more than $\frac{a}{2}$ from the centre is $\frac{1}{4}$.

Many very interesting problems have been solved, some of them by exceedingly ingenious methods, but this branch of the subject is quite special and cannot receive further attention here.

In what precedes some important parts of the theory have been indicated. A study of its important applications, notably those to the discussion of errors of observations and to problems of insurance, must be sought elsewhere. The growth of the importance of the subject has been remarkable, for in the beginning it was concerned with problems of gambling, and it has become the basis of all forms of insurance. It has attracted and held the deep attention of nearly all the ablest mathematicians from Cardan to Sylvester and Poincaré. Among its devotees have also been Pascal, Fermat, De Moivre, Leibnitz, the Bernoullis, D'Alembert, Euler, Lagrange, Bayes, Condorcet, Laplace, Poisson, De Morgan, Bertrand and Czuber. The theory has been applied freely, and in many cases rashly, too little attention having been paid to the fact that its applications really lie in the domain of those events whose occurrences may properly be compared to the drawings of balls from a bag. Hence it is necessary to exercise considerable care in connection with the literature of the subject. See LEAST SQUARE, METHOD OF; STATISTICAL METHOD.

Bibliography.— Bertrand, 'Calcul des Probabilités' (1889); De Morgan, 'An Essay on Probabilities' (1838); Laplace, 'Théorie Analytiques des Probabilités' (1812); Whitworth, 'Choice and Chance' (5th ed., 1901); Williamson, 'Integral Calculus' (London 1906; chapter on Probability).

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PROBATE, *in law,* legal proof of a will. In the United States, probate is granted usually by courts of special jurisdiction in the various States, but sometimes by chancery or common law courts. See WILL.

PROBATE, Court of. See COURT.

PROBATION, *in law,* a method of conditional release of persons convicted of crime, who are kept under constant surveillance and allowed their liberty during good behavior only. Usually the offender is under the supervision of a probation officer. The system originated in Massachusetts in 1878, and since then has grown rapidly in favor among penologists, as being expedient, economical, humane and tending to preserve the self-respect of transgressors. Usually only first offenders guilty of minor crimes are subject to probation. It was adopted in the United Kingdom by statute in 1908.

PROBATION AFTER DEATH, a doctrine favored by some modern theologians as a means of reconciling the idea of everlasting punishment with that of God's supreme mercy and the universal redemption through Jesus Christ: the doctrine differs from the doctrine of Universalism in postulating an intermediate state of the soul after death, of which Universalism knows nothing; and in rejecting the Universalist tenet that *all* will ultimately be saved. Something very like this doctrine of *post mortem* probation, and different from the Catholic doctrine regarding Purgatory, is taught by Clement of Alexandria (*Strom.* vi. 18): "Even if a man passes out of the flesh he must *put off his passions* ere he is able to enter the eternal dwelling." And he speaks of the angels "who preside over the ascent" of souls as detaining those who have *preserved "any worldly attachment."*

PROBLEMATISCHE NATUREN ('Problematical Natures'). Like Freytag and Paul Heyse, Friedrich Spielhagen was chiefly concerned, in his novels, with defining the warring elements of German character and the opposing springs of German action in the period before and after the revolution of 1848. Like Freytag and Heyse, Spielhagen saw clearly the dangers that threatened the country, politically, religiously and morally from a reactionary aristocracy; like Heyse and unlike Freytag he saw the hope of the nation in the spread of an enlightened democracy rather than in a spiritual renascence of the ruling classes. Oswald Stein, the hero of his most famous novel, ‘Problematische Naturen,’ is the mouthpiece for Spielhagen's revolutionary social theories. He is modelled after those characters of whom Goethe wrote «There are problematical natures that do not fit into any situation and who remain always unsatisfied. For them there arises a terrible conflict that consumes life without enjoyment.» For Spielhagen the conflict itself, even though it ends in defeat, is victory; the mere struggle against the domination of dead ideas is progress. For such a philosophy there could be no better historical background than the Germany of 1848 and after, and ‘Problematische Naturen’ with its sequel ‘Durch Nacht zum Licht,’ although it squanders material for half a dozen novels, idealizes Teutonic morbidity, and forsakes art for tendency, tells with remarkable vividness, the story of the men and women who lived and thought and fought for freedom in Germany's day of hope. A notable description of the literature of this period is to be found in Julian Schmidt's ‘Geschichte der Deutschen Literatur.’

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PROBOSCIS or **NOSE MONKEY,** a rare Bornean monkey (*Nasalis larvatus*), called «Kahau» by the natives, and characterized by a greatly elongated nose, giving a peculiarly ludicrous appearance to the face. The general body-color is a sandy red; the tail is dark above, but light yellow beneath. These monkeys are arboreal in habits, and appear to frequent the neighborhood of streams and rivers, congregating in troops. They are closely allied to the apes of the genus *Semnopithecus*.

PROBUS, Marcus Aurelius, Roman emperor: b. Sirmium, Pannonia, 232; d. there, 282. He early attracted the notice of the Emperor Valerian, who made him tribune and soon placed him at the head of a legion. The brilliancy of his conduct in the African, Persian, Arabian and Germanic campaigns brought him into still more prominent notice. He was made governor of all the Roman provinces in Asia by the Emperor Tacitus and when Florianus, who succeeded his brother Tacitus, was murdered in 276 Probus was immediately proclaimed emperor by universal consent. He drove back the Franks, Alemanni and Vandals, who had invaded Gaul; and in 277 secured the frontier wall between the Danube and the Rhine. He also freed the lands south of the Danube, Egypt and the East from devastating barbarian hordes and concluded an advantageous peace with the Persians. He gave new dignity to the senate, populated desolate tracts in Thrace and Mœsia with barbarians (280) and paid particular attention to agriculture. By 281 peace had been established almost everywhere throughout the Empire. Probus now, for the first time since his accession to the throne, found it possible to go to Rome where he celebrated a triumph either in 281 or 282. He kept his soldiers actively employed in public works. Irritated at being charged with occupations which they deemed degrading, a troop engaged in draining a swamp rose in insurrection and killed him. Probus ranks among the ablest of Roman emperors, combining the qualities of a good commander and wise statesman. Consult Dannhaüser, E., ‘Untersuchungen zur Geschichte des Kaisers Probus’ (1909).

PROBUS, Marcus Valerius, Roman grammarian: b. Berytus, Syria, second half of the 1st century A.D. He is chiefly noted for his critical revisions of the most important Latin poets, as for instance Lucretius, Horace and Virgil. He applied to them the methods of the Alexandrian school of critics. A commentary on the Bucolics and Georgics of Virgil under his name has been preserved but is of doubtful authenticity. A biography of Persius, written by him, remains in a commentary on the works of that poet. An extant fragment of his work ‘De Notis’ contains the abbreviations used for legal terms. Consult Aistermann, J., ‘De M. Valerio Probo Berytio’ (Bonn 1910).

PROCACCINI, prō-kät-chē'nē, the name of a family of artists of the 16th century who under the patronage of the Borromeo family, founded a distinct school of Italian painting at Milan, as the Caracci had done at Bologna. The members of this family were (1) ERCOLE PROCACCINI, called the Elder: b. Bologna, 1520; d. later than 1591. His works, principally at Bologna and Parma, are not remarkable for talent, but exhibit industry and care, although they are not free from the mannerism of his contemporaries. He was in great request as a teacher and after his removal to Milan became the founder of the famous school bearing his name. (2) CAMILLO PROCACCINI, son and pupil of the former: b. Bologna, 1546; d. Milan 1626. He was the most accomplished artist of this school. He profited by studying the school of the Caracci and took Correggio and Parmegiano for his models. His imitation of them is obvious from his work but the result is equally successful. His works are distinguished for spirited composition, exquisite coloring and devotional elevation, but are mannered. Among those at Milan are a ‘Madonna and Child’ in the church of Santa Maria del Carmine and an ‘Adoration of the Magi’ in the Brera. Many other churches in Milan contain works of his, as do also galleries in Bologna, Dresden, Leipzig, Munich, Stuttgart, Vienna, Madrid. (3) GIULIO CESARE PROCACCINI, brother of Camillo: b. Bologna, 1548; d. Milan, 1626. He likewise strove to equal the school of the Caracci and took for his model Correggio, whom he imitated with so much success that several of his pictures, though far from reaching the grace and harmony of that great master, have often been ascribed to him. This has been the case especially with cabinet pictures of the Fall. His works, all of a religious nature, are to be met with in many churches of Milan especially in the cathedral. In the Annunziata in Genoa is his ‘Last Supper,’ by some considered his masterpiece. Others of his works are in galleries in Florence, Genoa, Milan, Parma, Turin, Madrid, Edinburgh, Brussels, Berlin, Dresden, Munich, Petrograd, Stuttgart, Vienna. (4) CARLO ANTONIO PROCACCINI, youngest brother of the two preceding: b. Bologna, about 1555, d. about 1605. He, too, was a pupil of his father, but the least gifted of the three brothers. He painted landscapes, fruits and flowers. Much of his work went to Spain, though some may be found in private collections in Milan. (5) Ercole Procaccini, called the younger, son of Carlo Antonio: b. Milan, 1596; d. there, 1676. He was a pupil of his uncle Giulio Cesare whom he succeeded as head of the Procaccini School. He painted historical subjects and still life, excelling especially in the latter. Religious subjects by him can be seen in the church of Saint Maria Maggiore at Bergamo in the Brera, Milan, etc. Consult Blanc, C., 'Ecole Bolonaise' (Paris 1874).

PROCEDURE, *in law*, the methods of initiating and maintaining litigation, usually embracing practice, pleading, evidence and the rules governing them. The term is sometimes restricted in its meaning to include only practice. Three widely differing systems of procedure were early developed in England by the courts of common law, courts of admiralty and courts of equity. While changed by statute and otherwise from the early forms, these systems are preserved to-day generally throughout the British Empire and the United States.

As developed in the common law courts, procedure differed radically from that in the courts of admiralty and courts of equity, being distinguished by extreme formality; and as a consequence the substantive rights of the litigants were often entirely disregarded by the rigid manner in which the rules were applied. Dating back to an early period, civil actions in common law courts were commenced by the issuance of the original writ at the instance of the plaintiff, commanding the sheriff to summon the defendant to appear before the court. This writ gave jurisdiction to the court of the subject matter of the action and its service gave jurisdiction over the defendant. The court could compel the attendance of the defendant at any judicial proceeding by issuance of its process known as a judicial writ. The plaintiff's claim was set forth in a prescribed form in the declaration, stating the cause of action in one or more counts and ending with a prayer for relief. (See Complaint; Declaration). Then followed the plea or answer by the defendant, replication by the plaintiff and sometimes other pleadings, until an issue was reached. (See Answer; Plea; Pleading; Replication). The court then directed the attendance of the parties and witnesses at the trial, which was a formal examination of the material facts, usually before a jury. (See Jury; Trial). After verdict various remedies were provided for the unsuccessful party. For instance, he could move in arrest of judgment, for a new trial, for a writ summoning a new jury on the ground of misconduct, etc. After judgment the defeated party had a remedy by writ of error, which was acted upon by a higher court. This writ stated the cause of complaint in a general manner and the assignments of error pointed out the particular errors of law alleged to have been committed by the trial court. On denial of these specifications by the opposite party, an issue was raised, which resulted in an affirmance or reversal of the judgment of the lower court. (See Error; Writ). After final judgment the writ of execution followed, by which the judgment was enforced. This was usually effected by seizure of the person or property of the defendant.

Procedure in civil actions in the United States to-day is to a large extent founded on the common law, modified by statutes or by the adoption of codes. Each State has its own distinct system and this is true also of the Federal courts. In both Federal and State courts, civil actions generally are commenced by the service of process called summons upon the defendant. This writ is in some States served by the sheriff or his deputy, but in other States it may be served by the attorney or agent of the plaintiff. In the usual administration of justice to-day, judicial process is indispensable. Until notice is given, the court has acquired no jurisdiction whatever to proceed to judgment. Even in proceedings *in rem*, notice, either actual or constructive, is required in order that the judgment may be valid. (See Process; Summons). Subsequently to the service of the summons a declaration or complaint, stating the cause of action, is served on the defendant by the counsel for the plaintiff, after which may follow the plea, answer, demurrer and various other pleadings. A general demurrer by the defendant denies that a cause of action has been stated and thus a question of law arises to be decided by the court. If the defendant's demurrer is sustained, judgment is rendered for the defendant. In some States, if the defendant's demurrer is overruled, he is allowed to answer and the action proceeds. In some jurisdictions a motion to strike out immaterial matter has supplanted the demurrer as a remedy for formal defects. (See Demurrer). If the defendant fails to answer, judgment may be taken against him by default. By code in various States, including New York (1848), among other reforms, distinctions between pleading at law and equity have been abolished and liberal provisions made for amendments to pleadings. By statute in other States various similar reforms have been accomplished. In the Federal courts of the United States in actions at law, the procedure of the State in which the court is located is followed, but in equity proceedings the procedure of the State is ignored and made uniform throughout the United States by court rules. A change is foreshadowed, however, in the procedure in the Federal courts in actions at law by the majority report of the Senate Committee on Judiciary (1917), favoring a bill authorizing the Supreme Court to adopt rules regulating the procedure and making it uniform throughout the United States. This bill has also been indorsed by the American Bar Association. Pressure of more important legislation due to the war, however, has caused a postponement of action on the bill. The term "writ of execution" in England at the present day includes the following: elegit, sequestration, capias, fieri facias and attachment. In the United States not all these forms are in use in every jurisdiction, the subject being one that is regulated to a large extent by statute. (See Execution). The writ of error has been abolished in many jurisdictions in the United States and appeal substituted therefor. See Appeal.

Criminal procedure in England to-day is founded largely on the old system at common law in civil cases, which was superseded by the Judicature Acts, dating from 1873. The arrest of the defendant, usually by warrant, generally follows an indictment by a grand jury in the case of the graver offenses, felony or treason. In the case of the lesser offenses a criminal information is filed by the attorney-general or, in his absence, by the solicitor-general. After an indictment has been found by the grand jury (twelve of whom must concur), the defendant on pleading not guilty is tried by 12 jurors in open court. Until 1907 a verdict in a criminal case of guilt or innocence was final, no appeal existing on the facts. However, a writ of error would lie for mistakes in procedure. By the Criminal Appeal Act of 1907, the right of appeal was given. The law of procedure in criminal cases in Ireland largely follows that of England, while that of Scotland differs to some extent, being regulated by statute passed in 1887. The common law method of trying criminals by a jury of 12 has been adopted in modern times by some European countries. The English system of criminal procedure, almost in its entirety, has been adopted by many of the British colonies. In the United States, criminal procedure is governed largely by statute or by code, but in a general way the procedure in use in England is followed. See Criminal Law; Grand Jury; Indictment; Information.

Procedure in admiralty closely follows that of the civil law, and is exceedingly simple, in marked contrast to the formalities of the common law. An admiralty suit is commenced by the filing of a libel, or complaint, setting forth the nature of the action, after which process is served by a marshal or deputy. Process, in suits *in personam,* may be in the form of a monition in the nature of a summons to appear and answer the suit. In proceedings *in rem* the marshal seizes the vessel or other thing in controversy. The answer in admiralty courts corresponds to the plea of common law, and exceptions are equivalent to pleas in abatement and special pleas in bar. A monition need not necessarily be served personally on the respondent. The court seeks at all times to adjudicate the controversy on its merits, to avoid delays, surprises and unnecessary costs. The rules of practice in courts of admiralty in the United States are substantially the same as those in England, but they are subject to change at any time when found necessary. Unlike the Federal courts in actions at law, courts of admiralty do not conform to the practice of the State courts. Admiralty courts permit the adjudication of several causes in one proceeding if adapted to the ends of justice and if no inconvenience will result therefrom, even extending this to libels *in rem* and *in personam* and cases in contract and tort; but causes entirely unrelated may not be joined. The admiralty courts, in addition to civil jurisdiction, have also limited criminal jurisdiction, but when acting in criminal cases the procedure in some particulars conforms to that of the common law courts, including trial by jury. Appeals from final decrees in the United States are usually taken to the Circuit Court of Appeals, but in certain enumerated cases to the Supreme Court. By certiorari, in cases of great importance, the Supreme Court may review the judgment of the Circuit Court of Appeals. See Admiralty.

Equity procedure, like that of admiralty, lacks much of the formality of the common law. Suit is commenced by the complainant filing a bill, after which, in some jurisdictions in the United States, service of process, called the subpœna, is made on the respondent, who then may answer. On his failure to do so, the complainant is entitled to a decree in his favor. Formerly he could compel the respondent to answer by attachment. Replication by the complainant follows the answer of the respondent. Beyond this equity pleadings do not go, but amendments are allowed in lieu of further pleading. Demurrers and pleas are generally used in equity the same as at common law. Demurrers test the legal sufficiency of a pleading of the opposite party. Liberal provisions are usually made in equity practice for the amendment of demurrers. A plea in effect is a special answer, setting up some fact or facts as a cause for dismissing, delaying, or barring the suit, or why some part of the bill should not be answered. Pleas and demurrers are today viewed with some disfavor, as being dilatory and not going to the merits. Recently the Federal courts in the United States abolished pleas and demurrers, and substituted therefor motions and answers. In the absence of statutory modification the equity system does not provide for the trial of issues before a jury duly impaneled in that court, in which it differs radically from the common law. However, when the necessity of a jury arises, the equity court sends the issue to a court of law, where it is tried before a jury according to legal forms. The verdict thus rendered is returned to the court of equity. In the Federal courts usually and sometimes in other courts the judges who preside in the equity cases preside also over the trials at law. Issues are submitted to a jury at common law when material facts which are disputed seem doubtful to the judge of the equity court. Formerly a court of equity could not rehear a cause or reverse a decree after enrolment of the final decree, but to-day a court of equity may review and reverse its own decree on bill of review. This must be brought by a party to the original suit or by some party in privity with him. Appeal also may be taken from a final decree. Appellate jurisdiction must be invoked by appeal, and not by a bill of review. The subpœna in chancery suits to summon a respondent to answer was abolished in England in 1852, and service of a copy of the bill substituted, which practice is also followed by some jurisdictions in the United States. As stated above, by code in some of the States the distinctions between pleading in actions at common law and equity have been abolished. See Code; Equity; Subpœna.

Edward F. Donovan.

PROCESS, (1) *in anatomy,* an enlargement, such as the zygomatic process of the temporal bone, the vermiform process of the cerebellum, etc.; (2) *in botany,* any extension of the surface; a protrusion whether natural or monstrous; (3) *in law,* a term applied to the whole course of proceedings in a cause, real or personal, civil or criminal, from the original writ to the end of the suit; properly, the summons citing the party affected to appear in court at the return of the original writ. This was sometimes called original process, being founded upon the original writ; and also to distinguish it from mesne or intermediate process, which issues, pending the suit, upon some collateral interlocutory matter; as to summon witnesses, and the like; (4) the term generally applied to the various mechanical and chemical processes by means of which illustrations are reproduced in printing.

PROCESS OF LAW. See Due Process of Law.

PROCESSION, Religious, a solemn march of the clergy and people, attended with religious ceremonies, prayers, singing, etc., in the churches or streets of a town for the purpose of returning thanks for some divine blessing, petitioning for assistance in some great calamity, celebrating the consecration or visitation of church dignitaries, or drawing attention to some great doctrine of the Church. The practice of holding such processions is usually said to have been introduced into the Christian Church in the reign of Constantine. The most celebrated processions which now take place in the Roman Catholic Church are those of the eucharist on Corpus Christi day, and during the week in which it occurs. They owe their origin to John xxii. The processions in honor of Saint Mark and those on Candlemas and Palm Sunday are said to have been instituted by Gregory the Great. Instances of celebrations of this nature are to be found among the Jews in the Old Testament, and as a part of the symbolical worship of nature they were in use among the ancient heathens; thus they formed solemn processions about the fields, which had been sowed, and sprinkled them with holy water to increase their fertility, and to defend them from injuries. The festivals in honor of Bacchus, Ceres, Diana, and other divinities, among the Greeks and Romans, were solemnized with processions, in which the images of the gods were borne about; and similar rites are still found among most heathens. Among the Buddhists these ceremonials are especially imposing. The procession which accompanies the Emperor of China when he goes to offer sacrifices to an idol in some great pagoda is one of the most gorgeous description. In a more restricted sense the term is applied to the solemn entrance of the clergy and their assistants (choir, etc.) into the church proper for the purpose of holding a religious service, or of their departure to the sacristy after the service. Consult Eveillon, J., ‹De Processionibus Ecclesiasticis› (Paris 1641); Gretser, J., ‹De Catholicæ Ecclesiæ Sacris Processionibus› (Ingolstadt 1600); Vatar, D., ‹Des Processions de l'Église› (Paris 1705); Wordsworth, C., ‹Ceremonies and Processions of the Cathedral Church of Salisbury› (Cambridge 1901).

PROCESSION OF THE HOLY GHOST, in theology the relation in the Trinity between the Father and the Holy Ghost. The Western Churches believe in what is called the «double procession» as expressed in the Nicene Creed, «Who proceedeth from the Father and the Son.» The Greek Church maintains the «single procession» and omits the words «and the Son.» See Filioque.

PROCESSIONAL CROSSES. See Crosses and Crucifixes.

PROCIDA, prō'chē-dä, **John of,** an Italian physician and nobleman: b. Salerno, about 1210; d. Rome, 1298. The tradition which makes him the prime mover in the conspiracy alleged to have brought on the Sicilian Vespers (q.v.) has been discredited by careful investigators, but is the subject of a tragedy by James Sheridan Knowles (q.v.) (1840).

PROCIDA (ancient Prochyta), (1) an island in Italy, on the west side of the Gulf of Naples and about 12 miles southwest of Naples, lying nearly midway between the island of Ischia and the coast of the province of Naples. It is about three miles long, northeast to southwest, and little more than one mile broad. The principal town on the island is (2) Procida, or Castello di Procida, which stands on the southeast coast, 12 miles west of Naples. It is fortified, has a good harbor, and a considerable trade. There is a palace on the island which was occasionally used as a residence by the former kings of Naples. On festivals the women assume the Greek costume, consisting of a red upper garment with gold embroidery. It is from this island that John of Procida (q.v.), the reputed originator of the massacre known by the name of the «Sicilian Vespers,» takes his name. Pop. about 15,000.

PROCLAMATION OF EMANCIPATION. See Emancipation Proclamation.

PROCLAMATIONS, Executive, documents issued by an executive in accordance with the powers conferred or in fulfillment of the duties imposed on him by the constitution or expressly by statute, or even in regard to matters toward which it becomes desirable or necessary to draw the attention of the citizens. The issuance of such proclamations is not regulated by any general statute enacted by Congress, and for some, such as the Thanksgiving proclamation, no provision whatever has been made. In accordance with the specific authority conferred on him by the legislative branch of the government the executive may act with special authority in the sale of public lands, establishing forest reserves, applying special provisions of the tariff act, regulating the treatment and status of alien enemies, the jurisdiction of foreign consuls over disputes among seamen, proclaiming a state of war, and extending provisions of the copyright or patent laws to citizens of another country, etc. In time of war the executive's powers are vastly increased, including regulation of railroads and other public carriers, food and fuel supplies, press censorship, establishing blocades, granting pardon to deserters, internment of persons guilty of seditious utterances or of acts tending to impede the prosecution of the war, and not otherwise amenable to punishment or restraint. President Lincoln covered the greatest range in his proclamations, in several cases going to the extent of suspending the writ of habeas corpus in various places. The Supreme Court, however, condemned his suspension of the writ in localities outside the theatre of war. (See Executive; President). Consult Fairlie, J. A., ‹The National Administration of the United States› (New York 1905).

PROCLUS, philosopher of the Neo-Platonic school: b. Constantinople, 412; d. Athens, 485. He is usually called Diadocleus and sometimes the Lycian, because his parents came from Xanthus in Lycia. He received his first education at Alexandria from the famous Peripatetic Olympiodorus the elder, and completed it at Athens under Syrianus, who ultimately appointed him his successor, and under Asclepigenia, who had learned from her father Plutarchus the doctrines of the Orphic and Chaldaic mysteries and the united theurgic sciences. As a teacher at Athens he was very successful and not only endeavored to unite into a single whole all the philosophical schemes handed down from former ages, but made it his aim to embrace all religions by becoming filled with their spirit. Following out this maxim he composed hymns in honor of the pagan deities, defended and interpreted popular myths, and even conformed to the rites connected with their worship, and considered himself as under their protection. It was probably in consequence of this adherence to the ancient religion of Greece, in opposition to the decrees of the Christian emperors, that Proclus was compelled to withdraw from Athens. He traveled for a year in Asia to study the various religions of its inhabitants. All of them he held in reverence. On his return to Athens, where he remained till his death, he re-opened his school, but now performed his religious services in secret. By his pure morals and religious views he gave his scholars the idea that he had intimate intercourse with gods and demons, and could work miracles. He claims to resemble Plato in supporting his doctrines by an unbroken chain of reasoning, a method that had been altogether neglected by the previous Neo-Platonists. But these pretensions are not borne out by his works. A life of Proclus was written by Marinus, one of his scholars, and his successor in the school at Athens. His extant works include a 'Sketch of Astronomy,' in which he gave a short view of the systems of Hipparchus, Aristarchus and Ptolemy; 'The Theology of Plato'; 'Principles of Theology'; 'Principles of Philosophy'; 'Commentary on the Works and Days of Hesiod'; 'Life of Homer,' etc. Many of his works have been collected and edited by V. Cousin in 'Procli Opera' (6 vols., Paris 1820–27) and in 'Procli Opera Inedita' (Paris 1864). There are also various other editions of some of his writings by J. F. Boissonade (Leipzig 1820); G. F. Creuzer (3 vols., Frankfort o. M. 1820–22); G. Friedlein (Leipzig 1873), and C. E. C. Schneider (1847). Quite a number of his works have been translated into English. The oldest of these translations is called 'The Descripcion of the Sphere, or Frame of the Worlde' (Englysshed by W. Salysburye, London 1550?). The other translations, made by Thomas Taylor, are as follows: 'The Commentaries of Proclus on the Timaeus of Plato' (London 1820); 'The Fragments that Remain of the Last Writings of Proclus' (London 1825); 'The Philosophical and Mathematical Commentaries of Proclus on the First Book of Euclid's Elements and His Life by Marinus' (2 vols., London 1788–89); 'The Six Books of Proclus, the Platonic Successor, on the Theology of Plato, etc;. also a Translation of Proclus' Elements of Theology, etc.' (2 vols., London 1816); 'Select Theorems in Proof of the Perpetuity of Time' (in 'Ocellus Lucanus on the Nature of the Universe, etc.,' London 1831); 'Two Treatises of Proclus, etc.' (London 1833). There is also a French translation by P. Forcadel de Beziés, 'Deux Livres de Proclus, du Mouvement' (Paris 1542). Consult Altenburg, M., 'Die Methode der Hypothesis bei Platon, Aristoteles und Proklus' (Rostock 1905); Diehl, Ernst, 'Der Timaiostext des Proklos' (in 'Rheinisches Museum für Philologie,' n. s., Vol. LVIII, pp. 246–269, Frankfort o. M. 1903); Lindsay, J., 'Proclus as Constructive Philosopher' (in 'Hibbert Journal,' Vol. CIII, pp. 279–288, Boston 1917); Marinus, N., 'Vita Procli' (ed. by J. F. Boissonade, Leipzig 1814).

PROCONSUL and **PROPRÆTOR**, functionary of the ancient Roman Empire, to whom the administration of the provinces was entrusted; proconsul or proprætor being one whose term of office had expired as prætor or consul. The first consul who received the title of proconsul, was Q. Pubilius Philo in 327 B.C. This was done in order that he might conclude a campaign successfully begun in southern Italy. It was afterward provided by a law of C. Sempronius Gracchus that, at the consular and prætorial elections the senate should distribute the provinces into two consular and six prætorial provinces, for which the consuls and prætors should cast lots or divide them among themselves by agreement, a few days after their entrance upon their term of office, on the expiration of which they took the provinces allotted them. But in 55 B.C. it was provided by a decree of the senate that no consul or prætor should enter on the government of a province till five years after his surrender of office. As the number of provinces increased, proconsuls were appointed who had not previously held the office of consul. The duties of proconsuls or proprætors were the administration of justice, the supervision of provincial affairs, and the command of the troops. They were assisted in their duties by quæstors and legates. Within 30 days after his return to Rome the provincial governor was bound to make a report of his government. The Lex Julia in 61 B.C. further required that a copy of his report (*rationes*) should be deposited in the two chief cities of his province. He was liable to impeachment for extortion, peculation or embezzlement of the public money or for abuses in regard to the army. Notwithstanding these precautions the provinces were subjected to various oppressions and exactions. From the time of Augustus the government of some provinces was taken out of the hands of the proconsuls and proprætors, and entrusted to legates called procurators, or stewards of the Imperial household, who governed under the immediate direction of the emperor. See PROVINCE; PROCURATOR.

PROCOPIUS, prō-kō'pĭ-ŭs, Byzantine historian: b. Cæsarea, Palestine, about 500 A.D.; d. Constantinople, about 565 A.D. After practising as a rhetorician and advocate at Constantinople for a short time he brought himself so much into public notice that in 527 Belisarius made him his legal adviser and private secretary. He found abundant opportunity for seeking the making of history at first hand, for he accompanied Belisarius and counseled him on his most important campaigns. He was with him in Italy, Africa and Persia. About 542 he returned to Constantinople. The emperor Justinian made him senator and in 562 præfect of the city. He is the historian in chief to the reign of Justinian, to which his three most important works were devoted. These are the 'History of the Wars' (Historiæ) in eight books, the first two relating to the Persian War, the two following to the war with Vandals, and the rest to the Gothic War; the ‘Secret History’ (Anecdota), a secret and more personal history supplementing the more formal ‘History’; the ‘History of the Edifices, built or repaired by Justinian’ (Ctismata). Doubt has been thrown on the connection of Procopius with the ‘Anecdotes.’ They are the repository of the scandals of Justinian's reign, filled with accusations, often of a ridiculous and improbable nature against Justinian and Theodora. On the other hand the histories are of great value, characterized by accurate personal observation and truthful presentation of conditions. The best edition of the complete works is that contained in Dindorf's ‘Corpus Scriptorum Historiæ Byzantinæ’ (Bonn 1833–38). A more recent edition is that published by J. Haury, ‘Procopii Cæsariensis Opera Omnia’ (3 vols., Leipzig 1905–13). The publication of the original Greek text with an English translation by H. B. Dewig has been begun as part of the Loeb Classical Library under the title ‘Procopius’ (Vol. I, New York 1914; Vol. II, New York 1916). Consult Dahn, F., ‘Prokopius von Cæsarea’ (Berlin 1865); Haury, J., ‘Procopiana’ (Augsburg 1891); ‘Zur Beurteilung des Geschichtschreibers Prokopius von Cæsarea’ (Munich 1896–97).

PROCOPIUS, Andrew, Hussite chief: b. about 1380; d. Böhmisch-Brod, 30 May 1434. He was distinguished as Procopius the Great, or the Bald, from as contemporary at times associated with him known as Procopius the Lesser or Prokupek. He received a good education, traveled extensively and upon his return entered the priesthood, receiving the tonsure from which was derived his nickname, the Bald. He fought with the Hussites under Ziska, and in 1425 after Ziska's death was chosen commander of the Taborites, the main division of the Hussites, and quickly made himself master of a larger part of Bohemia. Defeating the German troops at Aussig in June 1426, he burned that town and soon after drove the Austrians across the Danube. Burning and laying waste large portions of Austria he led his bands toward Silesia; defeated a German army near Mies (1427); and in the next two years ravaged Silesa, Hungary and Saxony. The bands under the leadership of Procopius had by this time made the name of Hussites a terror throughout the provinces through which they pursued the armies of the Emperor Sigismund. Strife, however, ensued between the extremists, and the more moderate division known as the Calixtines, who in 1433 accepted the terms offered by the Roman Catholics. In a factional fight between the two parties Procopius was killed. In the same battle perished Procopius the Lesser, leader of a section of the Hussites called the Orphans, which had co-operated with the Taborites since 1427. Consult Sand, Georges, ‘Procope le Grand’ (in Œuvres illustrées,’ Vol. I, Paris 1855); Wolf, J. H., ‘Leben der beiden Prokope’ (Prague 1784).

PROCRUSTES, prō-krŭs'tēz, Attic robber, surnamed Polypemon of Damastes. He possessed a bed upon which he forced his guests to sleep, and if they were too tall to fit it he had their limbs chopped off, whereas, were they too short he had them stretched. The monster was outwitted by Theseus, who made him suffer of the same bed and slew him at Erineiis. The «bed of Procrustes» has thus become a proverbial expression. Another version represents him as having two beds, one short and one long, the first for tall visitors and the second for short ones. Consult Plutarch, ‘Lives’ (in ‘The Loeb Classical Library,’ Vol. I, London and New York 1914).

PROCTER, prŏk'tėr, **Adelaide Anne,** English poet, daughter of Bryan Waller Procter (q.v.): b. London, 30 Oct. 1825; d. there, 3 Feb. 1864. Her first verses were published in the ‘Book of Beauty’ in 1843. In 1853 she began to contribute to *Household Words* under the pseudonym «Mary Berwick,» and attracted much attention, gaining in particular the favorable notice of Dickens, who did much to aid the young poet. While her work is not great it is marked by deep feeling and tenderness. Her poems with few exceptions first appeared in either *Household Words* or *All the Year Round.* She became a Roman Catholic in 1851. In 1859 she was appointed by the National Association for the Promotion of Social Science a member of a committee to consider new ways of providing employment for women, having always been interested in social questions affecting women. Her collected poems were published under the title ‘Legends and Lyrics’ (1858), the 10th edition of which (1866) contains a biographical sketch of the author by Charles Dickens. Many of her poems have received a musical setting, the most famous being ‘The Lost Chord,’ which was set to music by Sir Arthur Sullivan.

PROCTER, Bryan Waller, «BARRY CORNWALL,» English poet: b. Leeds, 21 Nov. 1787; d. London, 5 Oct. 1874. He was educated at Harrow, subsequently studied law in London, and in 1831 was called to the bar of Gray's Inn. For many years he held the office of commissioner of lunacy, resigning in 1861. He had a particularly amiable disposition and a wide acquaintance among literary men of his day, being especially friendly with Leigh Hunt and Charles Lamb. His first appearance in literature was in 1819, when he published ‘Dramatic Scenes and Other Peoms.’ under the pseudonym of «Barry Cornwall,» which he afterward retained. Later works were ‘A Sicilian Story’ (1821); ‘Marcian Coloma’ (1820); ‘Mirandola’ (1821), a tragedy performed with great success at Covent Garden; ‘The Flood in Thessaly’ (1823); ‘English Songs and Other Small Poems’ (1832). His prose includes ‘Effigies Poeticæ, or the Portraits of the British Poets’ (1824); ‘Life of Edmund Kean’ (1835); ‘Essays and Tales’ (2 vols., Boston 1853); ‘Charles Lamb; a Memoir’ (1866). He will be longest remembered as a song writer, but even so his work has been somewhat overrated. He edited ‘The Works of Ben Jonson, with Memoir’ (1838); ‘The Works of Shakespeare, with Memoirs and Essay on his Genius’ (1843); ‘Essays of Elia, with a Memoir of Lamb’ (1879), and together with J. Foster ‘Selections from Browning’ (1863). Consult ‘Bryan Waller Procter, an Autobiographical Fragment and Biographical Notes’ (ed. by Coventry Patmore, 1877).

PROCTER, John Robert, American civil service reformer: b. Mason County, Ky., 16

March 1844; d. Washington, D. C., 12 Dec. 1903. He was educated at the University of Pennsylvania, but left there to join the Confederate army in 1863 and served until the end of the war. In 1873 he became assistant in the Kentucky geological survey, and in 1880 State geologist. In this office he was brought into contact with the spoils system, to which his opposition was so uncompromising that he finally lost his position in 1893. In the same year, however, he was appointed president of the Civil Service Commission, a post which he held till his death. His criticism of the spoils system was based not only on its evil moral and social effects, but also on its absurdity as a method of conducting business and this view he constantly presented most effectively. His work as president of the commission was the means of increasing the effectiveness of the civil service, and of gaining for it recognition in political life. He served as a member of the Jury of Awards at the Chicago World's Fair and was a frequent contributor to magazines and journals on geologic, economic and political subjects.

PROCTOR, prŏk'tŏr, **Alexander Phimister**, American sculptor: b. Ontario, Canada, 27 Sept. 1862. Soon after his birth his parents moved to Colorado where he was educated, studying later in New York art schools. He was the pupil of Puech and Ingalbert at Paris, and was awarded the Rinehart Paris scholarship. He has been a frequent exhibitor at expositions and has been awarded the following medals: Designers Medal, Chicago Exposition, 1893; Gold Medal, Paris 1900; Gold Medal, Saint Louis 1904; Gold Medal, Panama Pacific Exposition 1915. In 1904 he was made a member of the National Academy. Most of his works are representations of wild animals of which he has made a very close study by spending since early youth much time in hunting on the western plains and mountains. As a producing sculptor and as a critic of sculpture his reputation is high and he was appointed a member of the sculpture jury at the Paris Exposition of 1900 and at the Pan-American Exposition of 1901 at Buffalo, and a member of the New York Art Commission in 1903. Among his works were the quadriga which he furnished for the United States pavilion at the Paris Exposition of 1900 and which was much admired. Others of his sculptures may be seen in the parks of New York, Denver and Pittsburgh. The lions on the McKinley Monument in Buffalo were designed by him. Other works by him are in the Saint Louis Art Gallery and in the New York Metropolitan Museum of Art. Consult Nelson, W. H. de B., ‘Phimister Proctor: Canadian Sculptor’ (in *Canadian Magazine*, Vol. XLIV, p. 495, Toronto, 1915); Taft, L., ‘A. Phimister Proctor’ (in *Brush and Pencil*, Vol. II, p. 241, Chicago 1898).

PROCTOR, Edna Dean, American poet: b. Henniker, N. H., 18 Sept. 1829. She was educated in Concord, has traveled extensively in Europe, and has achieved a considerable reputation as a poet. Her most notable poems are ‘Heroes’ and ‘Shenandoah.’ Among her works are ‘Poems’ (1866); ‘Poems’ (Boston 1890); ‘The Song of the Ancient People’ (Boston 1893); ‘Mountain Maid and Other Poems of New Hampshire’ (Boston 1900); ‘Songs of America and Other Poems’ (Boston 1905); ‘The Glory of Toil and Other Poems’ (Boston 1916). Her only prose work, ‘A Russian Journey’ was first published in 1872, but revised editions of it have been brought out in 1890 and 1899. She has also contributed to various magazines.

PROCTOR, Redfield, American politician: b. Proctorsville, Vt., 1 June 1831; d. Washington, D. C., 4 March 1908. He was graduated from Dartmouth in 1851, and from the Albany Law School in 1860. He practised law a short time and in 1861 entered the Federal army as lieutenant; was soon promoted major and was mustered out as colonel. After a few years' law practice he devoted himself to business, acquiring large interests in marble quarries in Vermont. He began political life as a Republican member of the lower house of the Vermont legislature, being first elected to that body in 1867, and again in 1868 and 1888; he was a member and president *pro tem.* of the State senate in 1874 and 1875; in 1876 he was elected lieutenant-governor, and in 1878 governor of the State. During his administration he brought about several reforms in the State finances and system of taxation. In 1888 he was chairman of the Vermont delegation to the Republican National Convention, and again in 1896. In 1889 he was appointed Secretary of War by President Harrison, and gave especial attention to the improvement of coast and border defense. In 1891 he resigned his secretaryship to accept the appointment to the United States Senate for the unexpired term of Senator Edmunds, resigned, and in 1892 was elected to the Senate for the six years' term. In 1898 and 1904 he was re-elected. In 1898 he visited Cuba to investigate conditions in the island, and on his return delivered a speech in the Senate in regard to the reconcentrados, which aroused the attention of the whole country. The facts presented by him were also influential in determining the policy of intervention in Cuba by the United States. Consult Proctor, W. L., and Mrs. W. L. Proctor, ‘A Genealogy of Descendants of Robert Proctor of Concord and Chelmsford, Mass.’ (Ogdensburg, N. Y., 1898); ‘Redfield Proctor, Memorial Addresses’ (in Senate Document, No. 764, 60th Congress, 2d Session, Washington 1909).

PROCTOR, Richard Anthony, English astronomer: b. Chelsea, 23 March 1837; d. New York, 12 Sept. 1888. He was educated at King's College, London and Cambridge, and began to read for the bar, but in 1863 took up with enthusiasm the study of astronomy and mathematics. In 1866 he was elected a Fellow of the Royal Astronomical Society, and in 1872 one of its honorary secretaries and editor of its publications. He resigned these positions in 1873 and made a lecturing tour in this country. As a lecturer he became at once popular, having in eminent degree the gift of lucid exposition. A second tour to the United States in 1879 and a tour to Australia were followed by a second marriage and his settling at Saint Joseph, Mo., in 1881. In the same year he founded at London *Knowledge*, a scientific weekly, which in 1885, became a monthly. In 1887 he moved to Florida. He did much to popularize astronomy. His works include ‘Saturn and His System’ (1865); ‘Handbook of the Stars' (1866); 'Half-hours with the Telescope' (1868); 'Other Worlds Than Ours' (1870); 'Light Science for Leisure Hours'. (1871); 'The Sun' (1871); 'Elementary Astronomy' (1871); 'The Orbs Around Us' (1872); 'Essays in Astronomy' (1872); 'The Expanse of Heaven' (1873); 'The Borderland of Science' (1873); 'The Moon' (1873); 'The Transit of Venus' (1874); 'Our Place among Infinities' (1875); 'Myths and Marvels of Astronomy' (1877); 'The Universe of Stars' (1878); 'Flowers of the Sky' (1879); 'The Poetry of Astronomy' (1880); 'Easy Star Lessons' (1882); 'Familiar Science Studies' (1882); 'Mysteries of Time and Space' (1883); 'The Great Pyramid' (1883); 'The Universe of Suns' (1884); 'The Seasons' (1885); 'How to Play Whist' (1885); 'Other Suns Than Ours' (1887); 'Half Hours with the Stars' (1887).

PROCTOR (Lat., *procurator*), one who acts on another's behalf. It has in England these special significations: (1) In the convocations of the two ecclesastical provinces, Canterbury and York, respectively, the official who represents the lower clergy and the capitular bodies of cathedral and collegiate churches; (2) a person who manages another cause in an ecclesiastical court or in a court of admiralty; owing to changes in the administration of law, made in 1873 and 1875, the business formerly confined to proctors may now be conducted by solicitors; (3) in the universities of Oxford and Cambridge, two proctors in each are charged with the duty of preserving the peace and repressing disorder among the students; to this end they are empowered to inflict summary punishment and are assisted by a number of pro-proctors and special constables. The rights and duties of the proctors are more extensive at Oxford than at Cambridge, inasmuch as at Oxford they are ex officio members of all important committees and supervise all business transactions of the University. Both at Cambridge and at Oxford they are elected by the officials of the several colleges.

PROCTOR, Vt., village in the township of the same name, Rutland County, five miles northwest of Rutland on the Rutland Railroad. Some of the largest marble quarries in the world are located in the district and there are marble finishing works. Pop. township, 2,871; village, 2,756.

PROCURATOR, among the ancient Romans, an agent, steward, or overseer of an estate; at a later period the title of a provincial officer (see PROVINCE and PROCONSUL), who managed the revenue. In some of the small provinces, or in a part of a large province, the procurator discharged the office of a governor, and had the power of punishing capitally, as was the case with Pontius Pilate in Judæa, which was attached to the province of Syria. Procurator, in monasteries, is the conventual to whom is entrusted the care of the temporal concerns. *Procurator di San Marco* was the title of the chief officers or senators in the Venetian republic. Besides the nine actual *procuratori*, from among whom the doge was chosen, there were also many titular procurators, who paid a great sum for his title, which was much coveted by the Venetian patricians on account of the rank it conferred.

PROCURATOR-FISCAL, the public prosecutor in criminal cases which come up in Scotland before the sheriff, magistrates, or justices of the peace belonging to his district. He also performs duties corresponding to those usually performed by coroners. Only when the public interest is concerned must he originate a prosecution; and when complaint is made by a person in a case in which the private interest of the complainant is rather at stake than the public interest, the procurator-fiscal must merely give his concurrence to the prosecution, and not institute the proceedings. He may, however, act as the complainant's agent; but even when he does so, if he only gives his concurrence, he is not liable to an action for malicious prosecution.

PRODICUS, Greek sophist: he came from Julis in the island of Ceos and was a contemporary of Socrates. He is known only as the author of an apologue of 'Hercules and the Two Paths,' quoted by Xenophon, in which the young hero chooses the hard path of duty and turns his back on the flowery but dangerous path of pleasure. The Greek text of this work is to be found in 'Epicteti Enchridion' (pp. 99–107, Oxford 1804). There are also two English translations of it: 'The Choice of Hercules' (translated by Bishop Lowth, in Roach, J., 'Roach's Beauties of the Poets, etc.' London 1794); and 'The Judgment of Hercules' (translated by Layng, P., Eton 1748). Consult Conguy, E., 'De Prodico Ceio, etc.' (Paris 1857); Kleemann, A. R. von, 'Platon und Prodikos' (in 'Wiener Eranos,' p. 38, Vienna 1909); Welcker, 'Prodikos von Keos' (in 'Rheinisches Museum der Philologie,' Vol. I, pp. 1–39 and 533–545).

PRODUCER. See INTERNAL COMBUSTION ENGINE.

PRODUCTION, in political economy a division covering the source and progress of the creation of wealth as constituted in the production of articles having an exchangeable value; the word in this sense covering one of three divisions of which the others are distribution and consumption. The division deals with the process of production, circumstances favorable or unfavorable to it and the factors governing it, labor, land and capital. See POLITICAL ECONOMY.

PRODUCTION, Cost of. See POLITICAL ECONOMY.

PRŒTUS, prē'tŭs, in Greek mythology, king of Tiryns. According to Ovid he founded the kingdom after making peace with his twin-brother, Acrisius, who had driven him out of Argos. The tragic legend concerning him deals chiefly with the fate of his three daughters, the Prœtidæ. These, rendered mad by Hera or Dionysus, wandered through the Peloponnesus, in time communicating their frenzy to other women, so that they killed their children. One of the three sisters died, the other two were healed by the seer Melampus, who married one and was given a share in the kingdom, his brother, Bias, receiving also a share and marrying the other daughter.

PROFANITY. See BLASPHEMY; SWEARING, PROFANE.

PROFERT, *in law,* an exhibition of a record or paper in open court. When either party alleges any deed, he is generally obliged, by a rule of pleading, to make profert of such deed; that is, to produce it in court simultaneously with the pleading in which it is alleged.

PROFESSIONAL EDUCATION. See EDUCATION, PROFESSIONAL.

PROFESSIONAL AND TECHNICAL SCHOOLS. See EDUCATION, HIGHER; EDUCATION, PROFESSIONAL.

PROFESSIONAL WOMAN'S LEAGUE, The, an association founded and incorporated in New York in 1893, and composed of women engaged in the dramatic, musical, and literary professions. The dues are $7.50 per annum; the league holds a bazaar each year, gives occasional entertainments during the winter season and holds four regular meetings each month. Its headquarters are in New York City.

PROFESSOR, The, a novel by Charlotte Brontë, published in 1857. It was the first fiction that she produced but it failed to find a publisher until after her death. «The plot in itself is of no great interest,» remarks Mrs. Gaskell, the biographer of Charlotte Brontë, but «she never excelled one or two sketches of portraits which she has given in 'The Professor,' nor, in grace of womanhood, ever surpassed one of the female characters there described.» Consult MacDonald, F., 'Charlotte Brontë's Professor' (in *Cornhill Magazine*, n.s. Vol. XXXV, p. 519, London 1913).

PROFESSOR AT THE BREAKFAST TABLE, The, a work by Oliver Wendell Holmes (q.v.), first published serially in the *Atlantic Monthly* in 1859. It was published in book form in 1860 and has run since then into many editions. It furnishes a sequel to the well-known 'Autocrat of the Breakfast Table,' which it resembles in tone and construction. Consult Ives, G. B., 'A Bibliography of Oliver Wendell Holmes' (Boston 1907); Morse, J. T., Jr., 'Life and Letters of Oliver Wendell Holmes' (2 vols., Boston 1896).

PROFIT. See CAPITAL.

PROFIT SHARING, a method by which wage-earners receive a share of the profits of an industry in addition to wages. Strictly speaking, profit sharing implies that the bonus shall be given to workmen individually; but benefits and insurance, social and educational funds maintained out of the profits of a business are modified forms of profit sharing. Many systems of profit sharing also provide for the employees obtaining share in the capital stock on special terms, thus becoming part owners of the industry. Profit sharing differs from co-operation (q.v.), in that it is not democratic; both the initiative in establishing a system of profit sharing and the control of the industry rests with the employer. It is regarded, however, as a step toward co-operation. The International Congress on profit sharing in 1889 defined profit sharing as «an agreement freely entered into by which the employed receives a share of profits determined in advance.» The arguments advanced in favor of profit sharing are: (1) Its justice; inasmuch as labor is equally necessary with capital to the welfare and success of an industry, it should justly receive a part of the profits; (2) its practical effect; it tends to interest employees in their work, to increase their efficiency and their care of property. There are two lines of opposition to profit sharing: (1) From the employers, who claim that it is unjust that labor should share in the profits, when it does not share in the loss or risk of the business; and that profit sharing does not necessarily result in increased efficiency; and (2) from the workmen who claim that their freedom is restricted, especially as in many instances a long term of employment and sometimes restriction of labor organization are involved in a profit-sharing system; and that they obtain no compensating share in the management or control of the industry. Profit sharing has been successful in many industries, especially where the labor is skilled and wages large in proportion to total cost of production; on the other hand, many attempts to establish a profit-sharing system have failed, owing sometimes to industrial depression, sometimes to a trial too short to give fair results and sometimes to change in management. In the United States between 1889 and 1896, 50 firms had made trial of profit sharing; in the latter year, only 12 continued it permanently and five had abandoned it temporarily; in 1900, there were 23 firms with a system of profit sharing, 12 of which had adopted it within the year 1899–1900. In 1916 there were in operation in the United States 60 industrial and mercantile establishments with profit-sharing plans.

France formerly outranked other nations in the number and importance of successful profit-sharing enterprises. Among the more important ones are Maison Leclaire (1842) (painter), the Godin Familistère at Guise and the Bon Marché (q.v.). France can still claim to have been the leader in the establishment of profit-sharing. In numbers, however, it is now outranked by Great Britain. In 1913 there were 141 profit-sharing plans in existence in the latter country, against about 115 in France in 1912. Other countries having establishments with profit-sharing plans of one type or another are Germany, Holland, Switzerland, Italy, etc. Among the most important profit-sharing establishments of the United States are the Nelson Manufacturing Company of Saint Louis, Mo., the Eastman Kodak Company of Rochester, N. Y., the Underwood Typewriter Company of New York City, the Ward Baking Company of New York City and Sears, Roebuck and Company of Chicago, Ill. The Nelson Company established its system in 1886, which, besides the direct sharing in profits by the employees, provides for the payment of sickness and accident benefits by the company as a part of the costs of the business; the employees are also encouraged to buy stock in the company. In 1896 an agreement was made by which the employees of the cabinet-making shop were to gradually purchase and take the management of that department; by 1902 they had sole control. The Proctor and Gamble Company introduced profit-sharing in 1887; the arrangement was that the employees should receive a share in the net profits in the proportion that wages bore to the whole cost of production. The fact that the employees were largely unskilled labor with low wages and received the new arrangement with indifference made the management of the system particularly difficult. An improvement was made by classifying the employees into four groups in regard to interest in work, excellence of work and care of machinery and tools; the best in accordance with this classification received double the regular dividend, the second group, including the greater number of the employees, the regular dividend, the third group one half the dividend, and the fourth none at all. Since then various other changes have been made so that this concern cannot be any longer called a true profit-sharing establishment. In 1903, the United States Steel Corporation adopted direct profit sharing for its more responsible employees and a system whereby any of its employees may acquire stock on easy terms and as long as they remain in the employ of the company, may receive a bonus of $5 a year extra for each share after the first five years. Many other important industrial concerns in the United States have introduced modified or limited profit-sharing plans, among them being the Ford Motor Company, the Studebaker Corporation, etc. The most exhaustive study of profit-sharing in the United States was published by the United States Department of Labor, Bureau of Labor Statistics, Bulletin No. 208, Miscellaneous Series No. 13 (Washington 1916). It also contains a very full bibliography of the very extensive literature on the subject. Consult Adams, H. B., ed., 'History of Co-operation in the United States' (in *Johns Hopkins University Studies in Historical and Political Science*, Vol. VI, Baltimore 1888); Adams, T. S. and Sumner, H. L., 'Labor Problems' (New York 1905); Aves, E., 'Co-operative Industry' (London 1907); Böhmert, V. K., 'Die Gewinnbeteiligung' (Dresden 1903); Brandt, H., 'Gewinnbeteiligung und Ertragslohn' (Dresden 1907); Burritt, A. W., and others, 'Profit Sharing' (New York 1918); Bushill, T. W., 'Profit Sharing and the Labour Question' (London 1893); Duhamel, M., 'Participation aux bénéfices et participation au capital' (Lille 1912); Eliot, C. W., and others, 'Profit Sharing and Scientific Management' (Boston 1914); Fay, C. R., 'Co-partnership and Industry' (Cambridge 1913); George, W. L., 'Labour and Housing at Port Sunlight' (London 1909); Giddings, F. H., 'Profit Sharing' (in *17th Annual Report of the Massachusetts Bureau of Statistics*, Boston 1886); Gide, C., 'L'Actionnariat ouvrier' (Paris 1910); Gilman, N. P., 'A Dividend to Labor' (Boston 1899); id., 'Profit Sharing between Employer and Employee' (New York 1896); Granier, J., 'Les Actions de travail' (Paris 1910); Great Britain, Board of Trade, Department of Labour Statistics, 'Profit sharing and Labour Co-Partnership Abroad' (*Parliamentary Papers*, Cd. 7283, London 1914); id., 'Profit sharing and Labour Co-Partnership in the United Kingdom' (*Parliamentary Papers*, Cd. 6496, London 1912); Lloyd, H. D., 'Labor Co-Partnership' (New York 1898); National Civic Federation Welfare Department, 'Profit Sharing by American Employers' (New York 1916); Payer, André, 'La Participation aux bénéfices' (Paris 1911); Pease, E. R., 'Profit Sharing and Co-Partnership' (in *Fabian Tracts*, No. 170, London 1913); Peters, J. P., ed., 'Labor and Capital' (New York 1902); Price, L. L., 'Co-Operation and Co-Partnership' (London 1914); Robert, C., 'Leclaire, Biographie d'un homme utile' (Paris 1878); Schloss, D. F., 'Methods of Industrial Remuneration' (London 1907); Smith, J. C., 'Money and Profit Sharing' (London 1908); Taussig, F. W., 'Principles of Economics' (Vol. II, p. 303, New York 1915); taylor, S., 'Profit Sharing between Capital and Labour' (London 1884); Tolman, W. H., 'Social Engineering' (New York 1909); Trombert, A., 'La Participation aux bénéfices, guide pratique' (Paris 1912); Vanlaer, M., 'La Participation aux bénéfices' (Paris 1898); Waxweiler, E., 'La Participation aux Bénéfices' (Paris 1898); Williams, A., 'Co-Partnership and Profit Sharing' (New York 1913); Id., '28 Years of Co-Partnership at Guise' (London 1908).

PROGRESS, the advancement of the world, moral, mental and material, as exhibited in history. Physical science, which has so recently demonstrated the gradual improvement of material types in the animal and vegetable world, has compelled metaphysical speculation to conform its general principles to the axioms formulated by physical observation and experiment. The result of science, of historical inquiry, of inductive activity in every area of investigation may favor neither optimism nor pessimism. They have brought into philosophy a third term, and that is meliorism, a term employed to denote a doctrine so firmly based on fact that none can controvert it. Meliorism embodies the truth that as far as human experience and observation can extend there has been improvement in things, progress in the universe, advancement in the world. Pessimism becomes a contradiction in terms; for the physicist in his laboratory, the historian in his study, the sociologist in his inquiry among men, declares that things have been once worse than they are now, and that from the flower in the field to the beast in the stall, and from the beast in the stall to the working man, the ruler and the general condition of nations, things have been growing better. The lapse of centuries shows a sensible amelioration in the lot of humanity. The slave has been enfranchised, woman has been raised and enlightened, the rights of labor have been more and more recognized. These, however, are only social and political examples of that universal amelioration and progress by which a nebula is changed into a star, and a star into a peopled and conscious world. Meliorism is the principle that underlies all existence, organic or inorganic, and comprehends in its widely extending connotation the discovery of drugs that abolish pain, of economic institutions that diminish poverty, of intellectual institutions that make ignorance and incompetency more and more rare and of tolerance and enlightment which give more and more freedom to the creeds, tastes and idiosyncrasies of individual men. In whatever direction we look over the field of human activity we see this improvement manifesting itself, and the phenomena which are the basis of meliorism furnish the best argument for that hopeful optimism which, as many believe, alone can give the mind a philosophical creed that renders life tolerable.

Meliorism is the doctrine of the positivist, because it is no metaphysical system which interprets facts by *a priori* assumption; it is simply an induction from a summary of those facts which physical science has most recently set forth as the proud results of the newest, the most unbiased, and the most uncontrovertible deductions from experiment and observation, in the whole world of material, social and political phenomena. See MELIORISM.

PROGRESS OF POESY, The. 'The Progress of Poesy,' by Thomas Gray, was published, together with 'The Bard,' in a volume entitled 'Pindaric Odes,' printed at Horace Walpole's famous Strawberry Hill Press in 1757. Both poems are odes in the strict Pindaric form, consisting of strophe or turn, antistrophe or counterturn, and epode or stand, twice repeated. Gray has made the three corresponding parts of each of the three divisions identical in metrical form, thus giving the poems a symmetrical though complicated verse structure. In the piece under discussion Gray sings in exalted language first of the various sources of poetry, then of the power of harmony to lull the fiercer passions, to impart all graces of motion to the body, to compensate for the ills of life, and to arouse the mind to virtue. He then traces in scholarly fashion but always with the rapt "enthusiasm" of the ode, the progress of poetry from Greece to Italy and from Italy to England, describing in picturesque and suggestive language the three greatest English poets, who were his predecessors, viz.: Shakespeare, Milton and Dryden, alluding modestly to his own effort to wake the loftier tones of verse which have long been silent. The Pindarics were censured in their own time for their obscurity, and Gray was compelled to add explanatory notes. Even so they fell upon deaf ears. To-day they are recognized as indubitable classics, the carefully wrought work of a true poetic genius in whom learning and critical judgment go hand in hand with inspiration. Consult 'Selections from Gray' (edited by W. L. Phelps, The Athenaeum Press Series); 'English Poems of Gray' (edited by D. C. Tovey); essay on Gray by Matthew Arnold, 'Essays in Criticism' (2d series).

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PROGRESS AND POVERTY, a famous work by Henry George, written in 1877–79. The manuscript was declined by publishers, but finally D. Appleton and Company agreed to publish the book if the author would bear the cost of making the plates. The latter were made under the author's personal supervision in San Francisco. Before being shipped east, late in 1879, an 'Author's Proof Edition' of 500 copies was struck off. The first regular edition was brought out in January 1880. It soon went through many editions, both in the United States and England. It has also been translated into almost every modern language and it is claimed that more than 2,000,000 copies have been sold. The best recent edition is the 25th anniversary edition (New York 1916). The author seeks in this work to solve a problem and prescribe a remedy. The problem is: "Why, in the midst of a marvelous progress, is grinding poverty on the increase?" The remedy is to nationalize the land,— make it public property; leaving that already in use in the possession of those holding it, but confiscating the rent and abolishing all other forms of taxation. Though the principles established by the book were not altogether original, but more or less similar to those of the French economic school known as Physocrates (q.v.), they had never before received an equally lucid and popular treatment in the English language. They gave origin to the so-called Single-Tax movement (q.v.), a school of economic philosophy which has still many adherents. Consult Dixwell, G. B., 'Progress and Poverty: A Review of the Doctrines of Henry George' (Cambridge 1882); George, H., Jr., 'The Life of Henry George' (New York 1900); Longe, F. D., 'A Critical Examination of Mr. George's "Progress and Poverty"' (London 1883); Miller, J. B., 'Trade Organizations in Politics; also Progress and Robbery' (New York 1887); Stebbins, G. B., 'Progress from Poverty, etc.' (Chicago 1887); Taylor, E. R., 'Henry George, the Man' (in *20th Century Magazine*, Vol. VI, p. 13, Boston 1912); Toynbee, A., '"Progress and Poverty:" A Criticism of Mr. George' (London 1883).

PROGRESSION, *in mathematics,* a series or sequence of terms such that each quantity bears the same mathematical relation to the preceding. This relation may be either that of a difference or of a ratio; the first case is that of the *arithmetical progression,* the second that of the *geometrical series.*

In an arithmetical series each term is derived from the preceding by adding to it a constant, called the difference, which may have a plus sign or a minus sign, so that the series may either increase or decrease. In the accepted notation of the arithmetical progression, a is the first term, n the number of terms, d the difference, and l the last term. The value of the last term or of any (the nth) term may be determined from the formula, $l = a + (n - 1)d$, which is merely a notational statement of the evident fact that the coefficient of d in any term will be less by one than the number of term, so that the nth term must be the sum of the first term and of the difference taken $(n - 1)$ times. Letting s stand for the sum of n terms we may write in ascending or descending order:

$$s = a + (a + d) + (a + 2d) + \;.\;.\;.\;.\;.\; + (l - d) + l, \text{ or } s = l + (l - d) + (l - 2d) + \;.\;.\;.\;.\;.\;.\; + (a + d) = a.$$

Adding these two equations we get the equation, $2s = (a + l) + (a + l) + (a + l) + \ldots + (a + l) + (a + l)$, or $2s = n\,(a + l)$, it being evident that the factor $(a + l)$ occurs n times in the second term of the preceding equation. The formula for the sum will then be $s = \frac{n}{2}(a + l)$. Hence, if three of data are given as to an arithmetical series, that is, three of a, d, n, l, s, the fourth (and the fifth, in general) can be found by the regular processes of algebra. Moreover the *arithmetical mean* between two numbers, being the mid-term in a series in which the number of terms is odd, will be one-half the sum of the two numbers.

A geometrical progression is a series in which each successive term is derived from the preceding by multiplying it by a constant, called the ratio, which may be less or greater than unity, so that the series may decrease or increase, or may be either plus or minus, so that the terms may be either similar or constantly changing in sign. In the accepted notation of the geometrical progression, a is the first term, r the common ratio, l the last (or nth) term and s the sum of the series of n terms. The formula for l, the nth term, since the exponent of r increases by one in each term will be $l = ar^{n-1}$.

To derive the formula for the sum of n terms, get the difference of the two self-evident equations,

$s = a + ar + ar^2 + \ldots + ar^{n-1}$, and
$rs = ar + ar^3 + \ldots + ar^{n-1} + ar^n$.

The difference is $rs - s = ar^n - a$, or $(r-1)s = a(r^n - 1)$. The formula then is $s = \frac{a(r^n-1)}{r-1}$ or $\frac{rl-a}{r-1}$.

With any three of the quantities given in these two formulas the other two may be derived by the use of quadratic equations (and in one instance of logarithms). An interesting variation of the problem of the summation of a geometric series is to find the value of a repeating decimal or repetend; as, for example, to find the value of .545454 . . . . (or $.\dot{5}\dot{4}$). Here $a = .54$, $r = .01$, and $n = a$. As n increases without limit, the value of l approaches zero; hence in the formula for the sum, $\frac{rl-a}{r-1}$, rl becomes negligible, and the formula takes the form $\frac{-a}{r-1}$ or $\frac{a}{1-r}$. Substituting the values above we have $\frac{.54}{.1-.01} = \frac{6}{.11}$.

A *harmonical progression* is a series in which the reciprocals of the terms form an arithmetical series. Any problem relating to harmonical progressions may therefore be treated as problems in arithmetical progression by the mere inversion of each term. See SERIES.

PROGRESSIVE PARTY, The. In the half century following the Civil War four serious disagreements threatened to break up the political homogeneity of the Republican party. In the order of their occurrence these were the Liberal Republican movement of 1872, the Mugwump party of 1884, the silver issue of 1890 and the progressive movement of 1912. The last named was by far the most serious and took its rise in the nineties, being at first largely an agrarian movement in the Middle West. Many prominent members of the Republican party felt that their party in the State and national legislatures was dominated to a dangerous degree by the great corporations, including the railroad companies. The progressive spirit first took concrete form in the energetic protests voiced by Western Republicans against the tariff legislation enacted by their party in 1890, 1897 and in 1909. The Populists and Democrats secured several seats in Kansas and Minnesota upsetting for the first time the solid array of Republican States. Friction was constant within the old party and in 1910 the strength of the new movement was apparent in Congress when the Progressives secured the election of the Congressional Committee on Rules by the House itself and discarded the old method of appointment of the committee by speaker. The elections of 1910 showed the older Republicans of the «stand pat» type that they might no longer treat the Progressives as a factious, troublesome and uninfluential minority. The Progressives, foremost among whom were La Follette of Wisconsin, Cummings of Iowa, Dolliver of Iowa and Beveridge of Indiana were now most aggressive and their influence was felt by both Democrats and Republicans alike. When the presidential campaign of 1912 approached the movement had acquired such momentum and strength that its leaders thought seriously of wresting the control of the Republican party from its old-time leaders, of dictating its platform and running the party machinery generally. No leader of sufficient strength as a presidential possibility having been developed within the ranks of the Progressive Republicans, the majority declared for Theodore Roosevelt, ex-President of the United States. Delegates instructed to vote for the latter as Presidential candidate were sent to the Chicago Convention of 18-22 June 1912. The supporters of President Taft, however, by controlling the National Committee, were enabled to pass upon all contested seats in the convention, with the result that the majority of the Progressive delegates were unseated and the remainder, led by Roosevelt, withdrew. The call for an independent convention signed by the ablest of the Progressives was soon sent forth, and on 5 August Theodore Roosevelt of New York and Hiram Johnson of California were unanimausly chosen as candidates for the Presidency and Vice-Presidency respectively.

The objects of the Progressive party, as set forth in the incorporation papers issued at Albany, N. Y., on 31 July 1912, are as follows: «To promote by educational means and political action, social and industrial justice and political liberty in the State and Nation; to advocate such legislation and administration as will secure to the people the effective control of all of the agencies of their government; to promote such legislation as is demanded by the modern industrial revolution, and which will secure a better and more equitable diffusion of prosperity; and to take such political action as will result in the election to public office of candidates who are in accord with the policies and objects of the organization; and further, to unite in a common movement all associations and organizations formed for like purposes throughout the State of New York and the United States of America.» The preamble of the platform of the Progressive party states that «The conscience of the people in a time of grave National problems has called into being a new party, born of the Nation's awakened sense of justice.»

The Platform.— The main recommendations of the platform are as follows:

Preferential primaries for Presidential candidates; direct primaries for nomination of State and national officers; direct election of United States senators; the short ballot; the initiative, referendum and recall.

A more expeditious method of amending the Federal Constitution.

National jurisdiction on those problems which have expanded beyond reach of the individual States.

Social and industrial justice to be secured by legislation for the prevention of industrial accidents, occupational diseases, overwork, involuntary unemployment; the prohibition of child labor; the minimum wage for working women, with prohibition of night work for women and an eight-hour day for the same sex; one day's rest in seven for all wage-workers; the abolition of the convict contract labor system; protection against the hazards of sickness, irregular employment and old age through a system of social insurance; establishment of public continuation schools; the organization of workers, men and women, as a means of protecting their interests.

National regulation of interstate corporations through a strong Federal administrative commission.

The appointment of diplomatic and consular officers solely with a view to their special fitness and worth.

A protective tariff to equalize conditions of competition between the United States and foreign countries, both for the farmer and manufacturer, and which shall maintain for labor an adequate standard of living; an immediate downward revision; a non-partisan scientific tariff commission; the repeal of the Canadian reciprocity act.

Full and immediate inquiry into the high cost of living.

The improvement of the national currency system.

Conservation and national control of natural resources.

Development of our rivers, especially the Mississippi and its tributaries.

Use of the Panama Canal for American benefit, free from control of American railroads, and American coastwise trade to be exempt from tolls.

Public ownership of the natural resources of Alaska.

Equal suffrage to men and women.

Limitation of campaign contributions and expenditures.

Registration of lobbyists; prohibition of Federal appointees from holding office in state or national political organizations.

Restriction of the power of the courts.

Restriction as to injunctions and contempt proceedings in labor disputes.

Establishment of a Department of Labor.

The re-establishment of the Country Life Commission; development of agricultural credit and co-operation.

Establishment of a centralized National Health Service.

Revision of the patent law.

Power to value the physical property of railroads by the Inter-State Commerce Commission; abolition of the Commerce Court.

Construction of national highways; extension of the rural delivery system.

A graduated inheritance tax, and ratification of the income tax amendment to the Constitution.

Judicial and other peaceful means for settling international differences; an international agreement for the limitation of naval forces.

Protection of the rights of American citizenship at home and abroad.

Increased care of our immigrant population.

A wise and just policy of pensioning American soldiers and sailors and their widows and children.

Creation of a parcels post.

Extension and strict enforcement of the Civil Service Law.

Readjustment of the business methods of the national government.

Protection against worthless investments by means of new legislation creating governmental supervision.

The campaign that followed will not soon be forgotten by the generation that witnessed it. Great numbers of Republicans allied themselves with the new party and at the election, Roosevelt, the Progressive, received 4,126,020 votes, as compared with the 3,483,922 votes cast for Taft, the candidate of the stand patters. California, Michigan, Minnesota, Pennsylvania, South Dakota and Washington were carried by the Progressives, totalling 88 votes in the electoral college, while only Utah and Vermont, with eight electoral votes remained in the Republican column. The elections of 1914 showed a drift of the Progressives back to the old party, with the exception of California where a heavy Progressive majority was rolled up. By 1915 many Progressives felt that their party had served its purpose by defeating the reactionary elements of the old party and the breach was almost healed during the presidential campaign of 1916, in which Mr. Roosevelt, the leading Progressive, supported Mr. Hughes.

That perfect harmony did not prevail, however, was shown when the electoral vote of California was thrown to Wilson because of differences between Hughes and Johnson supporters in that State. The Congressional elections of 1918, however, showed that the breach had been closed and the Republican party again presented a united front to its doughty enemy, the Democrats. (See REPUBLICAN PARTY). Consult Anon., 'The Progressive Party, its Record from January to July 1916' (New York 1916); De Witt, B. P., 'The Progressive Movement' (New York 1915); Duncan-Clark, S. J., 'The Progressive Movement' (Boston 1913); McCarthy, C., 'The Wisconsin Idea' (New York 1914); Payne, G. H., 'The Birth of the New Party' (New York 1912); Roosevelt, T., 'Progressive Principles' (New York 1913); id., 'The Progressive Party' (in *Hibbert Journal*, Vol. XII, p. 1, London 1913); Walling, W. E., 'Progressivism — and after' (New York 1914); White, William Allen, 'The Old Order Changeth' (ib. 1913).

EDWARD C. CARRINGTON.

PROGRESSIVES, The. The term "Progressives," or more popularly, "Insurgents," was applied originally to those Republican Congressmen who contended that The House should itself elect the Committee on Rules, instead of allowing the Speaker to appoint the committee. These efforts, continued through several years, were finally successful on 17 March 1910, when such a change was ordered and the committee enlarged from five to ten members.

The name "Progressives" then assumed new importance and was applied especially to members of the Republican party in both branches of Congress who took issue with the administration of President Taft on several questions, notably the tariff, or who took what was generally considered advanced or "progressive" ground on other leading public measures. They have therefore added to their repertoire of policies and achievements, and been considerd sponsors for, or at least leading advocates of, many important public measures. The success of the Progressive movement not only almost reversed the political control of Congress in the elections of 1910, but paved the way for the formation of the Progressive Party (q.v.) in 1912, and largely shaped the Democratic platform in the same year.

PROHIBITION, used in a special sense, means the interdiction by law of the manufacture and sale of intoxicating liquors for use as beverages. Various forms of regulation or control over the liquor traffic have been adopted from time to time, but prohibition is the most drastic of them all. A prohibition wave swept over the Northern States about the middle of the 19th century, beginning in Maine, where the first State-wide prohibition law was enacted in 1846. A more stringent law was enacted in 1851 in the same State, and subsequently a prohibition amendment to the State constitution was adopted. Up to 1906, 18 States had adopted State-wide prohibition, but the wave had receded so that, by that year, only three States — Maine, Kansas and North Dakota — still remained in the prohibition column.

The recession of the prohibition wave indicated that the movement had proceeded too rapidly and that the goal must be won by slower steps. State-wide prohibition in many States undoubtedly was contrary to the wishes of a considerable minority of the people throughout the State and probably of a majority of the people in certain localities of the State. It is axiomatic that, in a democracy, sumptuary legislation is difficult to enforce unless supported by public opinion. Consequently, the line of least resistance in the movement for effective prohibition lay in introducing it only in those localities where the majority of the people favored it. This plan is carried out through what is known as local option, which is found in all but a few States where State-wide prohibition has not been adopted. Local option represents an effort to adjust the State liquor law to the sentiments and wishes of the majority of the people in particular localities. It enables such local majorities to vote out the open saloon from their neighborhoods. In States allowing local option, some or all of the various political subdivisions, such as townships, precincts, cities, villages and counties, are given the privilege of voting out the saloon. Local official bodies, such as city councils, are also given by law in some States the authority to license, regulate or prohibit the sale of intoxicating liquor within their jurisdictions. As a result of the spread of local option, a number of States not having State-wide prohibition are largely dry. Such dry territory in local option States, however, is only relatively dry. Where wet and dry townships or counties exist side by side in the same State, the introduction of liquor into dry territory from adjoining wet territory is difficult to prevent. Open sale of liquor in dry territory is usually prevented, but clandestine sales undoubtedly continue to be made to a considerable extent.

The comparative failure of local option in bringing about thorough prohibition has been one influence affecting the movement for the enactment of State-wide prohibition laws and constitutional amendments. Various prohibitory liquor laws of a partial character have been enacted in a number of States. Thus, we find laws prohibiting saloons to remain open on Sundays, election days, or after certain hours, and prohibiting the sale of liquor within a certain distance of educational and religious institutions. Congress has also prohibited the sale of liquor in the District of Columbia and on Indian reservations. Partial laws, however, have not been considered sufficient, and recently a new movement for State-wide prohibition has been under way, beginning with the enactment of the Georgia law in 1907. This movement spread especially in the South and West, so that, by the year 1918, more than half of the States had in force State-wide prohibitory liquor laws or constitutional provisions.

Dry States have experienced difficulty in enforcing their prohibition laws for various reasons. Too often they have depended largely on local officers to enforce the State law and such officers have frequently been influenced by anti-prohibition sentiment in their localities either to ignore the law or to enforce it in a very lax and inefficient manner. This difficulty has to some extent been avoided in a few States by the provision of special State machinery of enforcement. But, in North Dakota, an act authorizing the governor to appoint an enforcement commissioner to enforce the prohibition law was declared unconstitutional by the Supreme Court of the State on the ground that it violated the reserved right of the people to have such laws enforced by officers of their own selection. Difficulty in enforcing the State-wide prohibition laws has also been experienced on account of the inability of the States to prevent the introduction of liquor from wet States through the channels of interstate commerce, over which the States have no direct control. Congress, however, has done what it could to remedy this difficulty and to enable the dry States to enforce their prohibition laws. Thus, under the Wilson Original Package Act of 1890, all intoxicating liquor transported into any State was made, upon its arrival, subject to the operation of the laws of such State enacted in the exercise of its police powers. The Webb-Kenyon Act of 1913 prohibited the shipment from one State into another of intoxicating liquor intended to be used in any manner in violation of State law. The Webb-Kenyon Act is strengthened by a recent act of Congress prohibiting the solicitation of orders for liquor in dry territory by sending advertising matter through the mails and forbidding any person to order or cause intoxicating liquor to be transported in interstate commerce for beverage purposes into any prohibition State.

For some time the Prohibition Party, the Anti-Saloon League of America and other organizations have been working for national prohibition. The outbreak of the European War and the entrance of the United States into it strengthened their efforts and brought the movement to a head. In order to increase the efficiency of the fighting forces, it was made a punishable offense to sell intoxicating liquor to soldiers or sailors. Since the successful prosecution of the war depends not only on the efficiency of the fighting forces but also on that of the civil and industrial population, it was argued that prohibition should be extended to the nation. Accordingly a resolution was introduced in Congress proposing a prohibition amendment to the Constitution of the United States. In December 1917 this resolution passed Congress by the necessary two-thirds majority in both houses. The language of the proposed amendment is as follows:

> "Section 1. After one year from the ratification of this article the manufacture, sale, or transportation of intoxicating liquors within, the importation thereof into, or the exportation thereof from the United States and all territory subject to the jurisdiction thereof for beverage purposes is hereby prohibited.
>
> "Section 2. The Congress and the several States shall have concurrent power to enforce this article by appropriate legislation.
>
> "Section 3. This article shall be inoperative unless it shall have been ratified as an amendment to the Constitution by the legislatures of the several States, as provided in the Constitution, within seven years from the date of the submission hereof to the States by the Congress."

In 1919 this proposed amendment had been ratified by 45 States. See PROHIBITION PARTY.

Consult Committee of Fifty, 'Liquor Problem in its Legislative Aspects'; Reinsch, P. S., 'Readings on American State Government' (Chap. 7, New York City); Anti-Saloon League Year Book; Franklin, F., 'Prohibition and the States' (*North American Review*, 1918, pp. 231-238).

J. M. MATHEWS.

PROHIBITION PARTY, The. When the Prohibition idea rose to prominence, prior to the Civil War, the idea of its support through political action was not wholly absent. When the Republican party was formed, it was by many regarded as the party of Prohibitionists, and James G. Blaine so speaks of it in one of his early editorials. Myron H. Clark was elected governor of New York in 1856, almost directly on the prohibition issue, and there was in that campaign in New York State an "anti-dramshop party." With the Civil War the prohibition question was largely pushed out of the public mind and, during the war or the years which immediately followed it, a large number of States which had adopted prohibition went back to the license policy. Further, the liquor power was organized by the revenue taxation policy adopted by the Federal government, and the brewer for the first time appeared as a political factor in American affairs. The result was that, when the temperance element of the country began to turn its mind again to the anti-alcohol reform, it discovered that a new condition existed in American politics and that by far the greater part of the political leaders of both parties were unwilling to give any toleration to the prohibition idea. This resulted in an agitation, which began in the Independent Order of Good Templars and centred chiefly around the Rev. John Russell, a Methodist clergyman of the State of Michigan, beginning as early as 1867 and culminating in 1869, in May of which year the Right Worthy Grand Lodge, in session in Oswego, N. Y., took action which resulted in the calling of a convention to consider the advisability of forming a political party upon the basis of the prohibition issue. The call was signed by residents of some 20 States and resulted in the meeting of a convention of about 500 people in Farwell Hall in Chicago, 1 Sept. 1869. There were representatives present from 20 States, by far the greater part of them people who had never before taken part in political affairs and few of them widely known. Perhaps the most famous individual among them was Gerrit Smith of New York State, who had been prominent as an Abolitionist and had been a member of Congress. One of the few remaining survivors, when this is written, is Col. John Sobieski, an exiled Polish prince, who served in the Federal army during the Civil War and against Maximilian in Mexico. Women sat in this convention on equal terms with men, probably the first political convention of history in which that was the case. The convention was by no means a unit in deciding to form a new party and its formation was decided upon by little more than a majority vote.

The basis of the action taken, as deduced from a study of the literature of the party, may be briefly stated as follows:

> I. Since the government of this country is administered and must be administered by means of political parties, it is obligatory upon honest citizens so to associate themselves politically that the administration of government shall attain the ends for which government is ordained.
>
> II. The legalization of the liquor traffic, which robs, debauches and kills a vast multitude of the citizenship of this nation, together with the innocent who upon them depend and the unborn who will follow them in life, is in contravention of the first duties and the fundamental principles of government and repugnant to every right doctrine of political science.
>
> III. Therefore, and the more urgently since the existing legalization of such traffic presents an issue which overtowers in its importance all of the other issues of the age, it is the duty of honest citizens to associate themselves together in a political party pledged to the enactment and the enforcement of laws which shall take away from this traffic the protection of legality and shall place it under the ban of legal prohibition.

The Prohibition party first appeared at an election in Ohio, in the fall of the year when it was organized, and Republican-Prohibition candidates were voted for in both Maine and Minnesota that fall. In 1870 Prohibition tickets were nominated in six States and more than 20,000 Prohibition votes cast, not including 21,000 received in Massachusetts by Wendell Phillips, who, beside being the Prohibition candidate for governor, was also the candidate of the Labor party.

The first presidential election in which the Prohibition party appeared was in 1872, and from that time it has nominated candidates for every presidential election.

Much of the history of the party, so far as it is of general interest, may be best told in tabular form.

NATIONAL CHAIRMEN.

1869-72. John Russell.
1872-76. Simeon B. Chase.
1876-80. James Black......
1880-84. Gideon T. Stewart.
1884-87. John B. Finch.
1887-99. Samuel Dickie.
1899-1904. Oliver W. Stewart.
1904-12. Charles R. Jones.
1912. Virgil G. Hinshaw.

PRESIDENTIAL CANDIDATES.

1872. James Black, Pennsylvania.
1876. Gen. Green Clay Smith, Kentucky.
1880. Gen. Neal Dow, Maine.
1884. Ex-Governor John P. St. John, Kansas.
1888. Gen. Clinton B. Fisk, New Jersey.
1892. Gen. John Bidwell, California.
1896. Joshua Levering, Maryland.
1900. John G. Woolley, Illinois.
1904. Silas C. Swallow, Pennsylvania.
1908 and 1912. Eugene W. Chafin, Wisconsin.
1916. Ex-Governor J. Frank Hanly, Indiana.

Of these men, six were lawyers; two, St. John and Hanly, had served their States as governors; one (General Smith) was an early governor of Montana; three (Smith, Dow and Fisk) were generals in the Federal army in the Civil War, in which St. John was also a colonel; and Bidwell commanded the militia of California during the Civil War. Smith also served in the Mexican War. Both Smith and Bidwell were members of Congress before joining the Prohibition party. Swallow was a clergyman, as was also Smith in the closing years of his life.

VICE-PRESIDENTIAL CANDIDATES.

1872. John Russell, Michigan.
1876. Gideon T. Stewart, Ohio.
1880. Henry A. Thompson, Ohio.
1884. William Daniel, Maryland.
1888. John A. Brooks, Missouri.
1892. James B. Cranfill, Texas.
1896. Hale Johnson, Illinois.
1900. Henry B. Metcalf, Rhode Island.
1904. George W. Carroll, Texas.
1908 and 1912. Aaron S. Watkins, Ohio.
1916. Ira Landrith, Tennessee.

The votes cast for the presidential candidates of the Prohibition party during this period are recorded as follows:

1872	5,607	1896	130,617
1876	9,737	1900	209,469
1880	9,678	1904	258,205
1884	149,772	1908	253,231
1888	249,918	1912	207,828
1892	263,480	1916	221,329

The party may be said first to have attracted general attention in 1884, when the wide popularity of John P. St. John, who had left the Republican party because of its refusal to adopt prohibition, first resulted in an appreciable party vote and when votes were first cast for the party in almost every State of the Union. The fact that the vote nearly doubled in the next election created some political apprehension; but it remained practically stationary in 1892, and in 1896, owing to a split in the party and its desertion by those Prohibitionists who advocated the free coinage of silver (among whom John P. St. John was a leader) the vote was cut in half. In 1900, however, under the leadership of Oliver W. Stewart and with John G. Woolley, who ranked among the greatest of American orators, as a presidential candidate, the vote largely increased again and in 1904 came practically back to its high point.

But a bitter factional fight breaking out in the party during the 1904 campaign and the gaining of control in the party management, immediately thereafter, by the faction which regarded the mission of the party not specifically to win political victory but to support prohibition as an abstract principle ended, in the minds of most political students, the possibility that the Prohibition party should ever become a considerable political factor.

It should be noticed that there have always been two schools of thought in the Prohibition party, one of which may be called the strictly political, which insisted always upon absolutely independent political action and refusal to give support to non-partisan measures of any sort; the other might be called a "co-operative" school, which, while retaining political organization, was always willing to join hands in non-partisan efforts of all kind.

No history of the Prohibition party is complete without some notice of the large number of political ideas which had their first introduction to the world in Prohibition party platforms.

The first of these is Woman Suffrage, for which the Prohibition party began to declare in 1872 and has declared in every one of its national platforms. Of equal importance is the direct election of United States senators, for which the Prohibition party declared in the platform of its first nominating convention in 1872. Prison reform, lower railroad rates, postal savings banks, parcel post, regulation of interstate corporations, protection of government lands, civil service reform, cheap letter postage, are among the things for which the Prohibition party spoke before any other party gave them consideration. The tariff commission idea began with the Prohibition party, as did also the income tax; and the Prohibition party was the first to attack polygamy and the only political party that opposed the system of protected vice, for years so common in American cities.

It should be added that the Prohibition party built, in its entirety, the argument upon which the prohibition issues finally won. It is a popular error to suppose that the Prohibitionists were chiefly concerned with the moral aspects of the liquor problem. Their literature is strong upon that subject but they were the foremost students of the economic phases of the problem and as well of its relations to practical civics. The latest writers upon the movement have added almost nothing to the argument that was formulated by the Prohibitionists as early as 1888.

WILLIAM P. F. FERGUSON.

PROHIBITIVE DUTIES, the taxes or system of tariff imposed by a government on imported articles for the protection and encouragement of domestic industries, or as a retaliatory measure in the case of a nation thus discriminating against the productions of another, or favoring those of other countries. Protective duties in their various mutations present problems of great commercial and political importance, affecting, as they do, the value of the markets of one country in regard to those of another. See FREE TRADE; PROTECTION; UNITED STATES — HISTORY OF THE TARIFF.

PROJECTILES. To accomplish the damage or destruction of a target a projectile should have certain hardness, tenacity and weight. If it be soft and weak compared with the body struck, it will spread out laterally or break into pieces, and presenting an increased surface will meet with a greater resistance, and consequently will penetrate less than if it had retained its original form. High density gives to the mass the least possible volume, whereby the effect of the resistance offered by the air and by the body to be penetrated is diminished. Different materials have been used for projectiles. Stone, lead, wrought-iron steel, cast-iron, and chilled iron possess peculiar properties which render each advantageous according to the object to be attained.

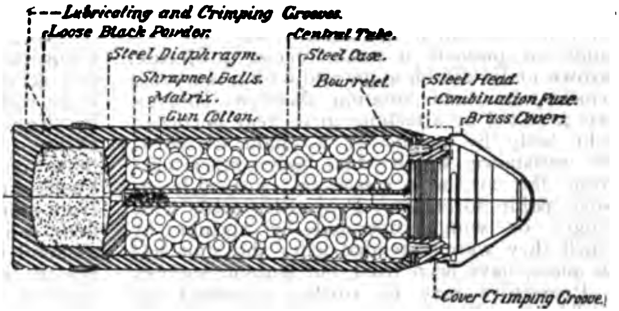
Prior to the invention of gunpowder, large masses of stone without regard to form were thrown from machines constructed for that purpose. This material was very generally employed until the year 1400; but its want of strength and density, qualities required in a projectile propelled by powder, necessitated its use in large masses and with comparatively small charges. Such projectiles were destructive against unbacked walls of masonry, but broke if ricocheted on earth. As late as 1807, stone balls of enormous calibre were used by the Turks in defending the passage of the Dardanelles.

Lead, as a material for projectiles, possesses the essential quality of density; but it is too soft to be used against very resisting objects, since it is flattened even against water. From its softness and fusibility, large projectiles of this material are liable to be disfigured, and partially melted, by the violent shock and great heat of large charges of powder. Its use is chiefly confined to small-arms and case-shot, which are generally directed against animate objects. These defects of lead may be corrected, in a measure, by alloying it with tin, antimony, etc. From the first introduction of cannon wrought-iron projectiles have at different times been tried. This metal has great density and tenacity, but has not a hard degree of hardness, cannot be easily worked into the necessary shapes, and where used in large masses becomes very expensive. Steel possesses the qualities required in a projectile, but is very costly and difficult to manipulate.

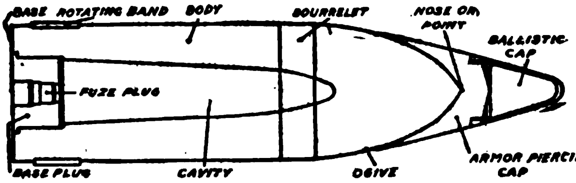
The adoption of cast-iron for projectiles caused an important advance in artillery. It has great hardness, sufficient density and tenacity; is cheap, easy to mold, and can at slight cost be given exact forms. Recent improvements in the manufacture of this metal have so greatly increased the strength of projectiles made from it, that they can be used effectively against heavy armor. Cast iron, chilled by being cooled rapidly, has its hardness, crushing strength and density increased. Projectiles so prepared are now employed with excellent results against the most powerful armor, and are found about as effective as those of steel and very much less costly. Compound projectiles, uniting the good and correcting the bad qualities of different metals, have sometimes been used. Thus, at the siege of Cadiz, cast-iron shells filled with lead, forming projectiles of great strength and density, were thrown from mortars to a distance of three miles and three-quarters.

Projectiles may be either *spherical* or *elongated*. Spherical projectiles are commonly used in smooth-bored cannon, and for this purpose have certain advantages over those of oblong form: (1) They touch the surface of the bore at only one point, and are therefore less liable to wedge in the bore and endanger the safety of the piece; (2) the centres of figure and inertia coincide; (3) the mass is embraced in the least possible volume; (4) as they turn over in their flight, the surface presented to the resistance of the air is uniform and a minimum; (5) in ricocheting on land or water, their rebounds are more certain and regular, and less derivation occurs from the plane of fire.

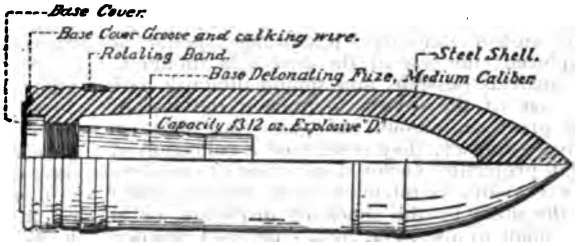
In order that any advantage may be gained from an oblong projectile, it must move through the air in the direction of its length; numerous unsuccessful attempts have been made to ensure accuracy in its flight when fired from a smooth-bored piece. One of the simplest plans for this purpose is to place the center of gravity, or inertia, in advance of the centre of figure, or resistance. As these points should be in the longer axis of the projectile, the force of inertia and the resistance of the air, acting along the same right line and in opposite directions, will tend to preserve the line of flight. This was tried on a hollow, pointed projectile in the time of Louis XIV; the cavity was divided into two compartments; the front one was filled with leaden balls and powder, and the rear one with powder only. The flight of these projectiles was uncertain and irregular, some of them bursting in the air, and others striking the object sidewise. Another plan of this kind, proposed by Thiroux, is to make the projectile very long, with its *rear* portion of wood, and its point of lead or iron, somewhat after the manner of an arrow.



COMMON SHRAPNEL.



ARMOR-PIERCING PROJECTILE.


Base Cover.
Base Cover Groove and calking wire.
Rotating Band.
Steel Shell.
Base Detonating Fuze, Medium Caliber.
Capacity 13.12 oz. Explosive 'D.'

COMMON STEEL SHELL.

Attempts have also been made to give an elongated projectile a motion of rotation around its longer axis: (1) By cutting spiral grooves on the base for the action of the gas from the charge; (2) by forming such grooves on the forward part for the action of the air; (3)

combining the preceding methods in the same projectile; (4) by causing the air to enter a cavity at the front end, pass through nearly the length of the cylinder, and escape by radical openings at the sides. None of these plans have succeeded in practice, for the reason, perhaps, that the projectile naturally turns over end for end, and the charge and the air do not act with sufficient promptness, energy, and certainty to prevent it. An oblong projectile, thrown under a high angle and with a moderate velocity, can have rotation about its shortest axis arrested by attaching to its rear portion a light body by means of a chain or cord; the resistance which this body experiences from the air will cause the projectile to move point foremost. Projectiles with wide flanges or wings, operated by springs by which they were extended after the shot left the piece, have been tried, but without success.

Projectiles may be further classified according to their construction and mode of operation, as *solid, hollow* and *case shot.* Solid projectiles produce their effect by impact; they are used in *guns* and in *small-arms;* those for guns are known as *solid shot* or *shot,* and those for small-arms as *bullets.* Such projectiles are required when great range, accuracy and penetration are sought; they must, therefore, possess great strength and density, and be fired with large charges of powder.

Shells are hollow shot which act both by impact and explosion, for which purpose they contain an explosive and a fuse to ignite it at the proper time. As they have less strength, they are fired with smaller charges of powder than solid projectiles, and are used against animate objects and such inanimate ones as will not cause them to break on striking. The thicker the sides of a shell, the greater its ability to resist the shock of discharge, and the greater the penetration and accuracy; on the other hand, a shell should be capable of containing sufficient explosive or incendiary material to accomplish the proposed end. The number of pieces resulting from an explosion varies with the brittleness of the metal, and is increased by giving to the interior the form of a regular polyhedron. A dodecahedral form has been found advantageous. The most rapid and violent explosive practicable should be employed; the size of the fuse-hole should be as small as possible, and should diminish with the size of the cavity, to prevent the loss of too great an amount of gas. Case-shot act only by impact; they consist of a collection of small projectiles enclosed in a case or envelope. The envelope is intended to be broken, either in the piece by the shock of discharge, or at any point of its flight, by a charge of powder, inclosed within it; in either case, the contained projectiles continue to move on after the rupture, but cover a large surface, and attain a greater number of objects. These projectiles can be used with effect only against animate objects situated at a short distance from the point of rupture; they are divided into *grape, canister* and *shrapnel.* Grenades are projectiles that are commonly thrown by hand, propelled by the rifle or otherwise. Larger projectiles of a similar type, designated as bombs, are propelled at low velocities by mortars or other forms of bomb throwers, or are rolled down the slopes of a work. They are designed to act only by the force of their own explosion. *Hand grenades* are thrown against troops in mass; for this purpose any spherical projectiles filled with powder only and weighing not over six pounds are suitable; these can be thrown from 20 to 30 yards; they are provided with a short fuse which is ignited with a match, or, in the act of throwing, by a special device. Projectiles have been designated especially for this service. *Rampart grenades* are intended to be rolled down a breach in its defense, or to be thrown over the rampart, etc. Spherical shells of any size will answer for this purpose; those unfit for firing may thus be utilized. Shells are fired from guns, from howitzers and from mortars. They are made of cast-iron and their calibre is expressed in the same manner as solid shot of an equal diameter, the thickness of metal in spherical shells is about *one-sixth* of the diameter, and their weight, when empty, is generally about *two-thirds* of that of the corresponding solid shot. In the United States service there are two kinds of spherical shells; one for guns and another for mortars. Each consists of the *sides,* the *cavity,* the *fuse-hole* and the *ears;* and, in gun-shells, the *reinforce.* The sides are thicker in gun-shells than in mortar shells of the same size, to withstand the high charge of powder with which they are fired. The fuse-hole is used for inserting the charge and to hold the fuse for communicating fire to it. All shells of eight inches or more in diameter have to receive the "hooks" used in lifting the projectile to the muzzle of the piece in loading. The reinforce of metal about the fuse-hole of the gun-shell gives a greater bearing surface to the fuse and prevents it from being driven in by the force of the discharge; this reinforce also serves, in a measure, to compensate for the metal taken out of the fuse-hole, and thereby render the shell more nearly concentric. In some services shells have in the upper hemisphere, a *charging-hole,* placed at an angle of 45° with the fuse-hole, through which the charge is poured immediately before the shell is used and after the fuse has been inserted. This is not necessary with the fuses used mostly in the United States service as the powder and fuse can be readily introduced at the moment of loading.

A carcass is a thick shell which has three additional holes of the same dimensions as the fuse-hole, pierced at equal distances apart in its upper hemisphere, their exterior openings being tangent to the great circle perpendicular to the axis of the fuse-hole. The object of a carcass is to set fire to wooden structures by the flame of an incendiary composition issuing from the holes. This shell has no fuse, and it is not intended to be exploded, although a charge of powder may be placed beneath the composition to prevent it from being approached by the enemy.

A stand of grape-shot is composed of nine small cast-iron balls, disposed in three balls each. The diameter of the balls for grape-shot varies with the size of the piece; being used at long distances, they are larger than the shot for the corresponding canister. Grape-shot are employed only in the siege and sea-coast services; as now constructed, they cannot be used in rifled pieces.

The envelope for a stand of canister-shot consists of a tin cylinder, closed at the bottom by a thick plate of cast-iron, and at the top by one of sheet-iron. The plates are kept in place by cutting the ends of the cylinders in strips about 0.5 inch long, which are turned down over the plates. A wire handle is attached to the top plate. To give more solidity to the mass, and to prevent the contained balls from crowding upon each other when the piece is fired, the interstices are closely packed with sawdust. For a gun 27 small cast-iron balls are used, arranged in four layers, the top of six and the remainder of seven each; this makes the diameter of the balls about one-third that of the bore. For howitzers the envelope contains 48 balls, in four layers of 12 each, the balls being smaller than those in a canister for the corresponding gun. Grape-shot and canister are no longer or seldom used, having been displaced by shrapnel.

Shrapnel are cast-iron shells, in which, besides the bursting charge of powder, is placed a number of small balls. Their sides are much thinner than those of ordinary shells in order that they may contain a greater number of bullets; the thickness must be such that, when supported by the bullets, the case will not be broken by the force of discharge, but will yield readily to a small bursting charge. The weight of the case, empty, is about one-half, and, when filled, about equal to that of the solid shot of the same diameter. This projectile is prepared by filling the case with leaden musket-balls well packed in; the interstices are then filled with melted rosin; this prevents the fracture of the envelope by the bullets when the piece is fired. The *chamber* for the powder is afterward bored out. The case is strengthened by a *reinforce,* and to increase the effect of the bursting-charge, the lower portion of the fuse-hole is closed by a *disc* of wrought-iron, perforated with a small hole for the passage of the flame from the fuse. A shrapnel may be made to explode at any point of its flight, and, as the bursting-charge should be only sufficient to open the envelope, without scattering the bullets too much, the execution depends on the velocity which the case has at the moment it is broken.

The advantages to be derived from the use of elongated projectiles having once been established, it became necessary that some means should be decided to make their flight accurate. It has been found that to do this with certainty a motion of rotation about its longer axis must be communicated to the projectile, and this end has been satisfactorily attained only by cutting spiral grooves, or «rifles» in the surface of the bore of the piece, with which the projectile is connected, and by means of which it starts with a motion about an axis parallel to or coincident with that of the bore. The rotation continues during the flight of the projectile. Without this rotation an elongated projectile will naturally turn over end for end and present a constantly varying surface to the resistance of the air. This «rifle-motion,» therefore, tends to cause the projectile to move through the air in the direction of least resistance, thereby increasing the range and the effect of impact, and, furthermore, giving steadiness to the projectile by distributing the deviating forces uniformly around its line of flight. The more important advantages of elongated projectiles are that the form may be altered at any time, and the centre of gravity can be placed at any desired point; the projectile may be elongated so as to oppose, for an equal weight, a diminished surface to any resting medium; by this the range is extended, and a flatter trajectory with greater accuracy and penetration obtained. The chief disadvantages are increased strain on the gun; greater probability of jamming and injury to the bore irregularity of ricochet; increased complication and expense of manufacture and the liability of any soft metal on the exterior to be accidentally injured.

The different systems of projectiles for rifled pieces are classified according to the manner in which they are caused to follow the grooves. The systems are distinguished by some peculiarity of construction and are generally known by the name of the person by whom designed or by the place at which first made. The same principles are applicable to different systems, and the same precision of fire may practically be obtained from several. All systems are comprised under three classes: (1) Projectiles with projecting ribs or studs, or having a peculiar cross-section. (2) Projectiles having a portion that is expanded by the action of the gasses in the bore. (3) Those more or less of whose surface is compressed by the charge into the form. The first and second classes are applicable to muzzle-loading pieces; the third to breech-loaders only. The principal points to be considered, as regards the piece and the projectile, are the *surest* and *safest* means of causing the projectile to follow the grooves of the piece. To fulfill these conditions the projectile should be simple in construction and of sufficient strength to admit of its use with the largest charge that may be desired; it must not be liable to jam in the bore in loading or firing, and must produce a moderate and uniform strain on the gun. The system that most nearly complies with these requirements, and gives insured accuracy of fire with uniform and high velocities, should be the best. In many systems, one or more of these considerations have been sacrificed to some extent, to secure a closer compliance with others thought to be of greater importance or of easier attainment.

1st Class.— Solid flanges, projecting from the body of a projectile, and so shaped as to fit the rifling of the bore, were the means first used to communicate the rifle-motion in cannon. In some cases there was for each groove a rib extending the entire length of the cylindrical portion of the projectile, while in others sets of rounded buttons were employed. These projections were of the same material as the body of the projectile, and, being of a very unyielding nature, frequently led to the bursting of the piece; buttons of zinc, copper or bronze, firmly secured in mortises in the projectiles, were therefore adopted. The buttons are arranged in rows or two or more so that each row enters freely into a corresponding groove, in loading. When the bore of a gun is a twisted prism, with any plane figure for its base, the projectile, if shaped to it, will receive the rifle-motion when fired. The Whitworth cannon is rifled in this manner, the cross-section being a hexagon with rounded corners. Guns have also been constructed with ribs projecting from the bore, fitting into corresponding grooves in the projectile. To the last system belongs the Vavasseur gun, which has given good results. The principal advantages of systems of the first class are that the projectiles are strong and that the required motion is communicated to them with great certainty and regularity. The escape of gas around the projectile, as it causes injury to the bore, is an objection to the class; various experiments have been made to overcome it, one being by the attachment of a metal cup to the rear of the projectile, which, by the action of the powder, is expanded and presses against the sides of the bore. The French studded projectile, employed with muzzle-loading cannon, and the Woolwich system, similar to it are the best representatives of this class.

2d Class.— In projectiles of the second class the body is composed of a hard metal, as cast-iron, and there is attached to it, generally at the base, a cup, band or other arrangement of softer metal, which is expanded by the action of the charge into the grooves of the gun, when fired. Expanding projectiles are easy to load, are not liable to overstrain the piece, and those of different systems can generally be fired from the same piece — a point of great importance. Such projectiles do not always withstand the heaviest charges of powder, and are not certain to receive the rifle motion. The use of projectiles of this class is confined more particularly to the United States.

3d Class.— In breech-loading cannon the receptacle for the charge is of a larger diameter than the bore of the piece. The projectile is of the same size as this chamber, and must be reduced to enable it to pass into the bore. Such projectiles are embraced under the third class; the body has a coating of soft metal, which is compressed as the projectile is driven through the bore, the grooves compelling it to follow the direction of the rifling. The same result is sometimes accomplished by one or more rings of soft metal. The chief advantages of this class are that the projectile is generally certain to take up the rifle-motion; that its axis is steady on leaving the bore, and that the wear of the bore, from gas passing the projectile or from any irregular movement of the latter, is prevented. The objections are that the necessary compression of the coating, the sudden closing of windage and the fouling of the bore produce undue strain upon the piece; that the velocity of the projectile is reduced by the force expended in compressing it; and that the soft metal forms an extra weight, which is useless in penetrating resisting objects.

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PROJECTION. (From the Latin *projicere,* to throw forward). In its general sense, the term signifies the representation of the form of a given figure upon a given surface by means of a pencil of visual, light, or other rays in such a manner that the figure in the projection corresponds point by point to the given figure. For example, shadows are the projections of objects upon different surfaces which intercept the rays of light from any source, not already intercepted by the objects themselves. They represent the most elementary forms of plane projections, and while corresponding in general outline to the objects projected, yet differ from them to a greater or lesser extent according to the distance of the object from the source of light, the distance of the plane of projection from the object, the angle between the plane of projection and the direction of the rays of light, the position of the observer's eye, etc.

In the mathematical construction of projections, however, instead of a single plane being used to intercept the projecting rays, another surface, such as one formed by two planes at right angles to each other, is taken and the various points of any object, plane or in space of three dimensions, projected to that surface from any point assumed as the center of the projection.

When the projection shows three dimensions of the object projected, it is commonly known as perspective, the mathematical theory of which together with the various classes of such projections employed in mechanics and for solving the problems of applied mathematics, will be found under the title Perspective in this Encyclopedia. The present article is confined to the consideration of the various projections used in connection with geographical and geodetical work in general, and to their employment in the construction of maps for special purposes.

In general the word «projection,» when used with reference to maps, has nothing whatever to do with geometrical projection from a point. It simply refers to a transformation of latitude and longitude on the spherical or spheroidal earth into planer magnitudes. A suitable introduction to this particular phase of the subject is given under the title Map in this Encyclopedia, wherein the three principal perspective projections of the sphere — the orthographic, the stereographic and the gnomonic, are clearly explained and illustrated. Of these, the orthographic and the stereographic are rarely used at the present time except in the construction of what may be called pictorial maps; but, the gnomonic and several of its modifications are extensively used for the construction of star charts in general, and especially for charts showing the apparent tracks of shooting stars on account of the facility in determining the radiant point, the great circles on the celestial sphere appearing as straight lines on the projection. For similar reasons it is used in the construction of sailing charts showing steamship routes, and is much more satisfactory for this purpose than Mercator's projection, which although almost universally used for nautical charts, is specially applicable for those used by sailing ships.

The chief value of the perspective projections lies in their adaptability for representing large areas of the earths surface. Usually, they represent a hemisphere; but, by the employment of the projection first proposed by Lahire in 1701 and subsequently modified by Lieut. Col. H. James of the Ordnance of Great Britain and Ireland, fully two-thirds of the sphere can be shown within the bounding circle. This is accomplished by assuming the eye above the sphere at a distance equal to half the radius and perpendicular over the center of the plane of projection. The plane of projection is not that of a great circle, but is parallel to it and removed from it nearer to the eye by 23 degrees.

A simple and easily constructed projection which can be effectively used in representing a hemisphere may be briefly described as follows: Draw a circle and bisect it by horizontal and vertical diameters; divide the circle into equal parts representing degrees of latitude; divide the vertical diameter into a corresponding number of equal parts; and divide the horizontal diameter into equal parts representing degrees of longitude. This will establish three points in every parallel of latitude, i.e., two in the circumference and one in the vertical diameter, through which the arc of a circle may be drawn representing the corresponding parallel of latitude, and also three points in every meridian, i.e., one at each pole and one in the horizontal diameter or equator, through which the arc of a circle may be drawn representing a meridian.

The general method of constructing developed projections has been briefly described under the title MAP in this Encyclopedia; but, as all modern maps representing data obtained from precise trigonometrical surveys are based upon some form of developed projection, the mathematical theory and the practical methods of construction of such will receive more extended treatment herein.

The various projections form three definite groups—(1) those possessing straight meridians and parallels, (2) those of mixed systems of straight and curved meridians and parallels, and (3) those in which both meridians and parallels appear as curved lines.

Of the first group, the one most extensively used is Mercator's projection. It was devised to satisfy the following condition: That the loxodromic curve or the course of a ship on the surface of the sea, under a constant bearing or intersecting the successive meridians at the same angle, shall appear on the projection as a straight line having the same angle of bearing with respect to the meridians intersected as that of the loxodromic curve.

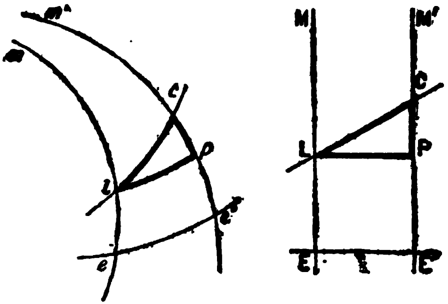

FIG. 1.

The formula used in computing a table of "meridional parts" or the "increased latitudes" for determining the distances of the various parallels of projecting latitudes from the equator, is obtained as follows: (Modified extract from Projection Tables published by the United States Hydrographic Office).

Referring to Fig. 1, let *l c* be an element of the loxodromic curve between two consecutive meridians *m e*, *m' e'*; and let L C represent the corresponding element on the projection between the corresponding meridians M E, M' E'. Let *l p* and L P be taken parallel to the corresponding equatorial elements *e e'* and E E' between the same meridians.

Then, the condition that the angles of bearing *l c p* and L C P shall be equal requires that

$$\frac{C\,P}{c\,p}=\frac{L\,P}{l\,p}$$

or since L P = E E' = e e' the element on the terrestrial equator, it is necessary that

$$\frac{C\,P}{c\,p}=\frac{e\,e}{l\,p}.$$

Hence, putting *d s* for the meridional element *c p* of the terrestrial spheroid, *d m* for the meridional element C P of the projection, *a* for the equatorial radius of the earth, and *r* for the radius of the parallel represented by the element *l p*; then, on account of the proportionality of the elemental arcs *e e*,' *l p*, to their respective radii *a*, *r*, we have the fundamental equation

$$\frac{d\,m}{d\,s}=\frac{a}{r}$$

which expresses the law of the Mercator projection.

Then, if L be the latitude of the terrestrial parallel under consideration, R the radius of curvature of the terrestrial meridian at its point of intersection with the parallel, *c* the compression of the earth, and *e* its meridional eccentricity; we have the folowing expression for the properties of *r*, R, and *e* of the terrestrial spheriod considered as an ellipsoid of revolution:

$$r=\frac{a-\cos L}{(l-e^2\sin^2 L)^{\frac{1}{2}}}$$

$$R=\frac{a\;(l-e^2)}{(1-e^2\sin^2 L)^{\frac{3}{2}}}$$

$$e=\sqrt{2c-c^2}.$$

Now, since the radius of curvature varies inversely as the angle between consecutive normals, the element of the terrestrial meridian at its intersection with any parallel of latitude is equal to the product of the radius of curvature and the element of latitude at that point, and

$$ds=R.\,dL,$$

which being substituted in the fundamental equation gives us the expression

$$dm=\frac{a\,R.\,dL}{r}$$

for the element of the projected meridian, or by substituting the preceding values of *r* and R, we have

$$dm=\frac{a\;(1-e^2)\;dL}{(1-e^2\sin^2 L)\cos L},$$

which when integrated between the proper limits give required length of any finite portion of the projected or chart meridian corresponding to the meridional arc on the terrestrial spheroid within the same limits.

For this integration, multiplying e^2 in the numerator by $\sin^2 L+\cos^2 L$, we have

$$dm=\frac{a.\,dL}{\cos L}-\frac{ae^2\cos L.\,dL}{1-e^2\sin^2 L},$$

again, multiplying the numerator and denominator of the first term by cos L, substituting $1-\sin^2 L$ for $\cos^2 L$, and resolving both terms into partial fractions, we have the expression

$$dm=\frac{a}{2}\left(\frac{\cos L}{1+\sin L}+\frac{\cos L}{1-\sin L}\right)dL-\frac{ae}{2}\left(\frac{e\cos L}{1+e\sin L}+\frac{e\cos L}{1-e\sin L}\right)dL,$$

whence, by performing the integration or the limits of O and L, we find for the length of that part of the meridian of the projection included between the equator and the parallel of latitude L, the expression

$$m=\frac{a}{M}\left(\frac{1}{2}\log\frac{1+\sin L}{1-\sin L}-\frac{1}{2}\,e\log\frac{1+e\sin L}{1-e\sin L}\right),$$

in which the logarithms belongs to the common system, of which M is the modulus.

Substituting for

$$\frac{1+\sin L}{1-\sin L}$$

its trigonometrical equivalent, and for

$$\log\frac{1+e\sin L}{1-e\sin L}$$

its algebraic development, we have the final expression

$$m=\frac{a}{M}\log\tan\left(45^\circ+\frac{L}{2}\right)$$
$$-\,a\,(e^2\sin L+\tfrac{1}{3}e^4\sin^3 L+\tfrac{1}{5}e^6\sin^5 L.)$$

which is the formula required for computing the meridional parts for the terrestrial spheroid.

This formula consists of two parts — the first term being the ordinary formula for computing meridional parts with the earth regarded as a sphere, while the second term consists of a series of negative terms, and represents the correction which must be applied for the meridional eccentricity of the earth under the hypothesis that it is an ellipsoid of revolution.

In using the formula to compute the accompanying table, the following numerical values with their respective logarithms have been employed for the several constants.

The equatorial radius is expressed in minutes of arc, therefore, the unit of measure of the meridional part *m* becomes a minute of the equator or a geographical mile.

$$a=\frac{10{,}800'}{\pi}=3437'.74677\ldots\ldots\ \log 3.5362739.$$

The reciprocal of the modulus of the common logarithms,

$$\frac{1}{M}=2.3025851\ldots\ldots\ldots\ldots\ldots\ldots\ \log 0.3622157.$$

Bessel's determination of the compression,

$$c=\frac{1}{100.1528}=0.003342773\ldots\ldots\ \log 7.5241069.$$

The meridional eccentricity of the earth,

$$e=\sqrt{2c-c^2}=0.0816968\ldots\ldots\log 8.9122052.$$

The values of the several coefficients with their logarithms deduced are as follows:

$$\frac{a}{M}=7915'.7055\ldots\ldots\ldots\ldots\ldots\ldots\ \log 3.8984896$$
$$ae^2=\ 22'.9448\ldots\ldots\ldots\ldots\ldots\ \log 1.3606843$$
$$\tfrac{1}{3}\,ae^4=\ 0'.05104731\ldots\ldots\ldots\ \log 8.7079734$$
$$\tfrac{1}{5}\,ae^6=\ 0'.000204425\ldots\ldots\ldots\ \log 6.3105351$$

On account of the rapid convergence of the series of coefficients involving the eccentricity, two terms are generally sufficient for practical use, and the formula becomes

$$m=7915'.7055\log\tan\ 45^\circ+\frac{L}{2}-22'.9448$$
$$\sin L+0'.05104731\ \sin^3 L.$$

TABLE OF MERIDIONAL PARTS OR INCREASED LATITUDES FOR THE TERRESTRIAL SPHEROID — COMPRESSION $\frac{1}{299.1528}$.

Lats.	Increased Lats. (M.)	Lats.	Increased Lats. (M.)	Lats.	Increased Lats. (M.)
°	′	°	′	°	′
1	59.60	31	1,946.19	61	4,629.12
2	119.22	32	2,016.22	62	4,754.69
3	178.88	33	2,087.02	63	4,884.46
4	238.59	34	2,158.64	64	5,018.76
5	298.38	35	2,231.12	65	5,157.98
6	358.26	36	2,304.49	66	5,302.51
7	418.25	37	2,378.81	67	5,452.84
8	478.37	38	2,454.12	68	5,609.50
9	538.64	39	2,530.48	69	5,773.10
10	599.09	40	2,607.93	70	5,944.31
11	659.71	41	2,686.53	71	6,123.96
12	720.55	42	2,766.34	72	6,312.97
13	738.62	43	2,847.43	73	6,512.44
14	842.93	44	2,929.86	74	6,723.64
15	904.52	45	3,013.70	75	6,948.13
16	966.40	46	3,099.02	76	7,187.76
17	1,028.59	47	3,185.91	77	7,444.80
18	1,091.12	48	3,274.46	78	7,722.07
19	1,154.01	49	3,364.74	79	8,023.14
20	1,217.29	50	3,456.87	80	8,352.55
21	1,280.97	51	3,550.95	81	8,716.35
22	1,345.09	52	3,647.09	82	9,122.69
23	1,409.66	53	3,745.41	83	9,582.99
24	1,474.72	54	3,846.05	84	10,114.02
25	1,540.29	55	3,949.14	85	10,741.71
26	1,606.41	56	4,054.85	86	11,509.61
27	1,673.10	57	4,163.35	87	12,499.22
28	1,740.38	58	4,274.81	88	13,803.54
29	1,808.31	59	4,389.44	89	16,267.70
30	1,876.90	60	4,507.46	90	Infinity.

On account of the space limitations the table gives the meridional parts for even degrees of latitude only; the values for intermediate minutes or seconds of arc may be computed by the formula.

If the chart for which the projection is made includes the equator, the values given may be measured off for the successive degrees of latitude directly from the equator; but, if the equator is not included in the map, the parallels of latitude to be projected should be successively measured from a principal parallel, preferably the lowest parallel drawn upon the map, and the distance of any parallel from the principal parallel will be the difference of the values given for the two in the table.

These values, given in minutes of arc, may be converted into their equivalents in inches, yards, meters, etc., and laid off on the projection by means of properly divided corresponding scales, proportionately to the scale adopted for the map, or the values given may be laid off without previous numerical conversion, by means of a diagonal scale constructed on the map.

For example — suppose a Mercator projection is required to embrace the coasts of Iceland, on a scale of 1-inch = 150 statute miles. This island lies between latitudes 63° and 67° north, and between longitudes 13° and 25° west from Greenwich. The projection will include four degrees of latitude and 12 degrees of longitude. The central meridian will correspond to longitude 19° W., and the lowest parallel will correspond to latitude 65° N. See Fig. 2.

Draw in the centre of the sheet a vertical straight line A B, for the central meridian, and near the bottom of the map construct very carefully a horizontal line C D, at right angles to A B, for the parallel of 63° N., and assume it as the principal parallel of the map. From the table obtain the value 4884′.46 for lat. 63° and 5452′.84 for lat. 67°, the difference of which or 5452′.84 — 4884′.46 = 568′.38, the value of the meridional arc included between the lowest and the highest parallels of latitude of the map, for which one minute of arc of the equator = 1.012 statute miles is taken as the unit of measurement. Converting this value to its equivalent in statute miles and reducing it to the scale of the map, gives 568′.38 ÷ 60′ = 9°.47; 9°.47 × 69.77 statute miles (equivalent to a degree of longitude on the equator) = 660.72 statute miles; 660.72 ÷ 150 = 4.40 inches or the distance of the parallel of 67° from the parallel of 63° on the map, on a scale of 1-inch = 150 statute miles. It is obvious that this measurement may be laid off on the map by means of any scale divided to the decimals of an inch, and the distance of each of the other parallels from the principal may be obtained by the same method of conversion, and laid off in a similar manner; but, having obtained the value 4.40 inches equal to the vertical extent of the map, we are enabled to determine a constant multiplier by the use of which the tabular values may be laid off directly by means of a diagonal scale (q.v.) of one inch without previous numerical conversion. As 1′ of arc of the equator is taken as the unit of the meridional

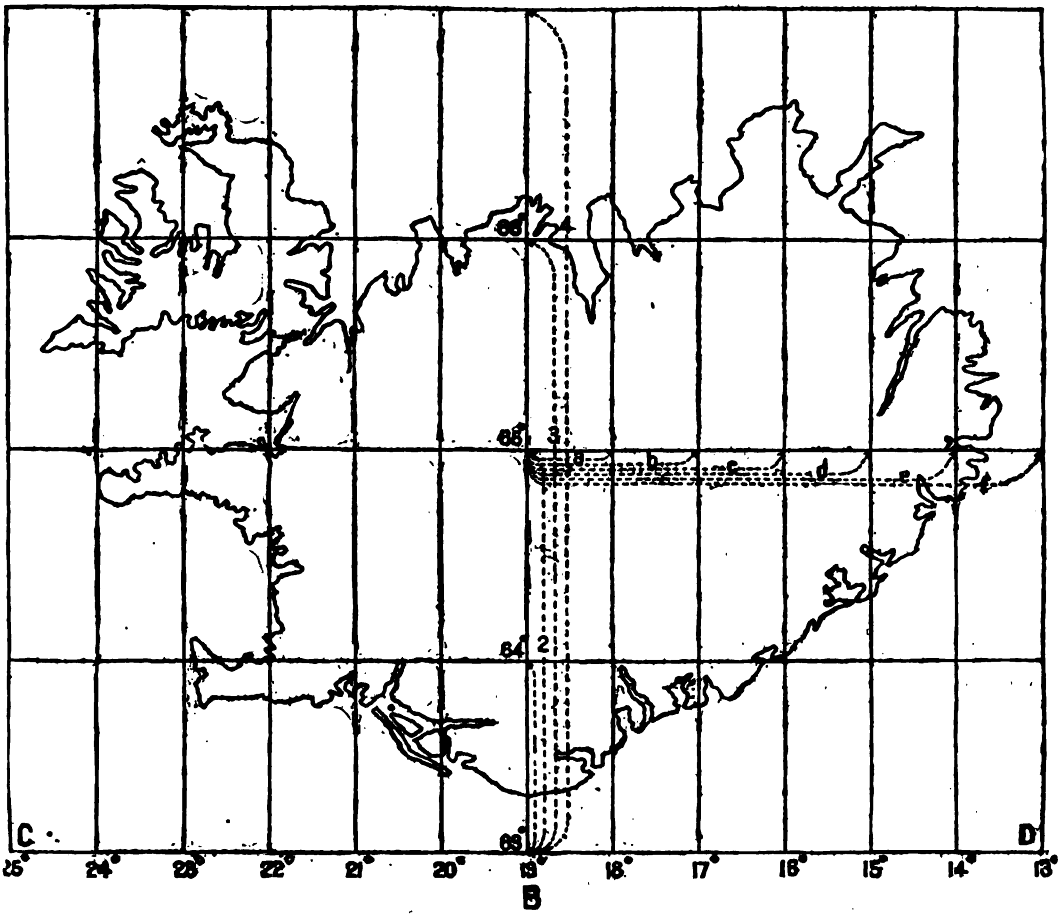

FIG. 2.

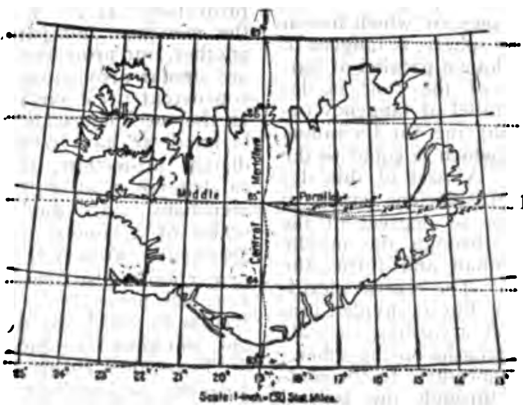

FIG. 4.

arc, 1′ of arc of latitude will measure 4.40 inches + 568′.38 = 0.0077 inches, which corresponds to the scale of the map and by which all the values obtained from the table must be multiplied if they are to be laid off on the projection by means of a diagonal scale of one inch.

The distances of the successive parallels from the parallel of 63° thus obtained are as follows:

$$0.0077 \times (5018.76 - 4884.46) = 1.03 \text{ in. } (64°)$$
$$0.0077 \times (5157.98 - 4884.46) = 2.11 \text{ in. } (65°)$$
$$0.0077 \times (5302.51 - 4884.46) = 3.22 \text{ in. } (66°)$$
$$0.0077 \times (5452.84 - 4884.46) = 4.40 \text{ in. } (67°)$$

These distances may now be laid off upon the central meridian from its intersection with the principal parallel in the order 1, 2, 3, 4 shown on Fig. 2, and through the points thus obtained straight lines may be drawn parallel to the principal parallel, and corresponding to the terrestrial latitudes of 64°. 65°, 66° and 67°.

On this map, a degree of longitude will measure 0.0077 inches × 60 = 0.46 inches and the distances of the successive full degrees of longitude east and west of the central meridian will be 0.46, 0.92, 1.39, 1.83, 2.31, 2.77 inches. Lay off these values on the lowest, middle and highest parallels of latitude, east and west from the central meridian, in the order a, b, c, d, e, f, and through the points thus obtained draw straight lines parallel to the central meridian and corresponding to the terrestrial longitudes of 13°, 14°, 15°, 16°, 17°, 18°, 19°, 20°, 21°, 22°, 23°, 24° and 25°, west from Greenwich. Another important projection in which both meridians and parallels are represented by straight lines is the cylindrical equal area projection, formed by projecting the surface of the earth from its axis on to a cylinder tangent at the equator and unrolling. While showing extreme distortion in regions remote from the equator, this map has the valuable property of representing areas truly.

The second group of projections, those having mixed systems of straight and curved meridians and parallels, including various kinds of «equal surface» and «conic» projections, of which the «simple conic» is the most valuable for general purposes. In this projection it is assumed that a cone, the apex of which lies in the axis (produced) of the sphere, is tangent to the surface of the sphere along a parallel of latitude. When the surface of the cone is developed on a plane, the parallel of tangency becomes an arc of a circle, having for its radius the slant side of the cone which is equal to the cotangent of the latitude. A part of this developed arc of a circle, of sufficient length to include the desired number of degrees of the proposed map, is drawn through the middle point of the central meridian and forms the middle parallel of the map. The central meridian north and south of this line is divided into degrees of latitude laid off according to scale proportional to their true lengths on the sphere, and parallels of latitude concentric to the middle parallel are drawn through the several points thus obtained. In a similar manner, the middle parallel is divided into degrees of longitude east and west of the central meridian and straight lines representing meridians are drawn through those points to the centre from which the concentric parallels were swept. In the system of co-ordinates thus established, the parallels and meridians intersect each other at right angles, precisely the same as on the sphere. The lengths of the degrees on the central meridian and on the middle parallel are proportionately the same as those on the sphere, and the lengths of the degrees on all the other meridians and parallels are but slightly different from what they would be if laid off their true length proportioned to those of the sphere.

In general, a conical projection is one which transforms the meridians into a pencil of straight lines, the angle between two of which is in a fixed ratio to the angle between the two meridians which they represent. The parallels will then form a family of concentric circles, and the particular form of the projection will be determined by the relation which the radius of such a circle will bear to the polar distance of the corresponding parallel. Let the radius of the circle be r, the polar distance ρ, the angle between a meridian and a fixed meridian of reference on the sphere be θ and on the map ϕ, Let our unit of distance be the radius of the earth. It is clear that the method of mapping will be completely determined by the equations

$$r = f(\rho)$$
$$\phi = c\,\theta.$$

The scale of representation of meridian distances on the map at (ρ_1, θ_1) will be $\frac{dr}{d\rho} = f'(\rho_1)$ The scale of representation of distances along the parallels will be $\frac{cf(\rho_1)}{\sin \rho_1}$. If our scale of representation is to be the same in all directions, $r = k\left(\tan\frac{\rho}{2}\right)^c$, where k is an arbitrary constant. This gives what is known as the orthomorphic conical projection. If the scale representation at a point ρ remains fixed, while c decreases toward O, the map will approach a mercator projection. If $c = 1$, the angles between meridians on the map will equal those on the earth, and we shall have the stereographic projection. If $c = 1$, no matter what relation the meridian and parallel scales bear to one another, our projection is said to be zenithal, as are similar projections, where other families of concurrent great circles replace the meridians. If the meridian scale of a zenithal projection is fixed we have what is known as the equidistant projection; if the projection is conical but not zenithal it is said to have rectified meridians. If the meridian and parallel scales of a conical projection are reciprocals, areas are preserved proportionally. If the projection is also zenithal it is sometimes called Lorgna's projection. A form of zenithal projection in which the deformation is distributed and minimized is due to Sir George Airy.

Two other forms of projection which may keep the meridians or the parallels straight are that of Mollweide, in which parallels are straight lines and meridians ellipses, and areas are retained, although with great deformation of the peripheral parts of the map, and the projection which simply plots in cartesian co-ordinates the spherical or spheroidal co-ordinates of points on the surface of the earth with reference to any given great circle or ellipse.

Of the projections, one of the most useful and extensively used is that devised by Bonne. It is sometimes called Flamsteed's modified projection, but the latter, which is more correctly Sanson's projection, is really the particular case of the former, in which the parallel of reference is the equator. Bonne's projection differs from the «simple conic» in that each of the concentric parallels of latitude is divided into degrees of longitude, the lengths of which are proportional to their true lengths on the sphere, and curved meridians are drawn through each corresponding series of points. The central meridian remains a straight line and the curvature of the arcs of the successive parallels is the same as that of the middle parallel, the radius of which is equal to the cotangent of the corresponding latitude. Thus, all the meridians intersect a parallel near the middle parallel at right angles and the outlines of areas on the projection are very nearly similar to those on the sphere. It not only preserves the proportionate equality of the areas on the sphere and projection, but permits of the use of the same linear scale for all parts of maps of only a few degrees in extent. This projection was adopted as the base for the important map of France constructed by the depôt de la Guerre in 1803.

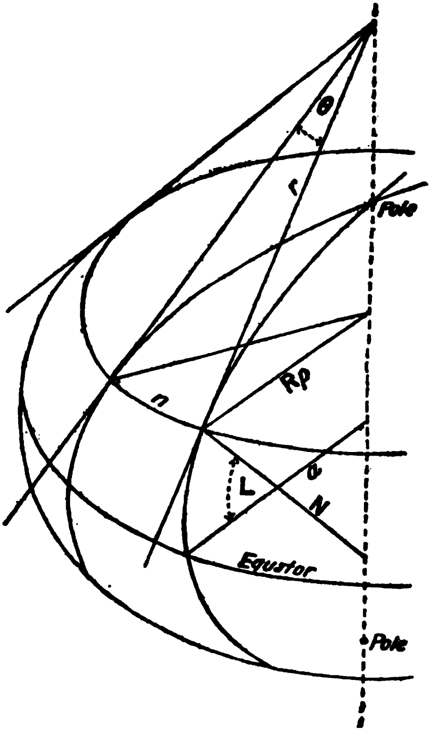

Fig. 3.

The step from the simple conic to the Bonne was an important one; but, the great obliquity of the meridians and parallels in the higher latitudes made it unsuitable for maps of large extent and led to the invention of the «polyconic» projection, which appears to have been conceived by F. R. Hasler, superintendent of the United States Coast and Geodetic Survey, between 1816 and 1820. It was proposed by him as the most suitable base for the maps of the Atlantic Coast of the United States, the great length of which, north and south, together with its direction nearly diagonal to the meridians and parallels, made it subject to inadmissible deviations in magnitude and figure upon a Bonne projection.

In the simple polyconic projection, it is assumed that each parallel of latitude is developed upon its own cone, the vertex of which is on the axis of the sphere at its intersection with the tangent to the meridian at the parallel. Theoretically, this involves the employment of an infinite number of tangent cones and the independent development of an infinite number of parallels of latitude. This has the effect of increasing the lengths of the successive degrees of latitudes and longitudes as their distances from the central meridian increases; but the angles at which the meridians intersect the parallels, over the entire map, very closely approximate to right angles, thus preserving a close similarity between the figure on the projection and the corresponding figures on the sphere.

The mathematical theory of this projection may be briefly stated as follows: Referring to Fig. 3, the equatorial radius being a, the eccentricity e, and the latitude L, the normal produced to the minor axis is

$$N = \frac{a}{(1 - e^2 \sin^2 L)^{\frac{1}{2}}}$$

the radius of the parallel

$$Rp = N \cos L;$$

and the sides of the tangent cone or radius of the developed parallel

$$r = N \cot L.$$

If n be any arc of the parallel to be developed, and θ the angle which subtends it at the vertex when developed

$$\theta = n \sin L;$$

and as the developed parallels are circular arcs. the co-ordinates of curvature are

$$x = r \sin \theta,$$
$$y = r \operatorname{versin} \theta = 2r \sin^2 \tfrac{1}{2} \theta = x \tan \tfrac{1}{2} \theta.$$

The radius of curvature in the meridian is

$$Rm = \frac{a(1 - e^2)}{(1 - e^2 \sin^2 L)^{\frac{3}{2}}} = \frac{N_3\, 1 - e^2}{a_2};$$

whence the length of a degree of latitude is

$$3600\ Rm \sin 1''.$$

and that of a degree of longitude is

$$3600\ Rp \sin 1''.$$

For maps of large extent on a small scale, it is sufficient to compute r and θ, x and y, for every whole degree, but for those of small extent, on a large scale, a more detailed projection becomes necessary and these values have to be computed to every minute or fraction of a minute according to the nature of the data to be represented, and the value of the scale adopted.

To make a projection from the data furnished by a polyconic projection table, draw a straight vertical line for the central meridian and lay off thereon the distances corresponding to the intervals between the successive latitudes required, and through the points thus obtained draw horizontal lines at right angles to the central meridian. These horizontal lines will be tangent to the developed parallels.

Now suppose, that as in the case of the Mercator projection hereinbefore illustrated, the polyconic projection is required to embrace the coast of Iceland, which lies between lat. 63° and 67° north, and between long. 13° and 25° west from Greenwich, and that the scale of the map is adopted at 1-inch = 150 statute miles.

Referring to Fig. 4, inserted under Fig. 2, the central meridian of the map will correspond to long. 19° west, and the middle parallel will correspond to 65° north. On the central meridian lay off to the north from its intersection with the middle parallel, according to the adopted scale, 69.268 miles for lat. 66°, and 69.277 miles for lat. 67°, and in a similar manner lay off to the south, 69.258 miles for lat. 64°, and 69.248 miles for lat. 63°. Through these points draw horizontal lines at right angles to the central meridian, and upon each of them set off to the east and to the west of the central meridian the values of x given in the table for the corresponding parallels of latitude. Through the points x, x^1, x^2, etc., thus obtained, draw perpendiculars toward the pole, and on them set off the proper tabular values of y. Through the final points thus obtained, draw continuous curves for parallels of latitude and meridians.

Space limitations in this Encyclopedia make it absolutely impossible to insert a polyconic table computed to even full degrees only, and one giving the values of x and y for greater latitudinal and longitudinal intervals would be more or less useless. Tables of this kind may be readily obtained from the United States Coast and Geodetic Survey, and the United States Hydrographic Office, Navy Department.

Fig. 4 is placed under Fig. 2 in order to afford a direct comparison of the two projections.

In the rectangular polyconic projection, while the parallels are the same as in the simple polyconic projection and the central parallel retains the same graduation, the meridians are orthogonal trajectories of the parallels.

Bibliography.— For further information consult the various authorities given under the title MAP in this Encyclopedia. Consult also d'Avezac, 'Coup d'oeil historique sur la projection des cartes géographiques' (in the publications of the Société de géographie de Paris for 1683); Craig, T., 'A Treatise on Projections' (Washington 1882); Germain, A., 'Traite des projections des cartes géographiques' (Paris 1865).

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PROJECTION, Oblique and Axonometric. See DRAWING, MECHANICAL.

PROJECTIVE GEOMETRY. See GEOMETRY, PURE PROJECTIVE.

PROLAPSUS ANI, falling of the anus. See RECTUM.

PROLAPSUS UTERI, falling of the womb. See WOMB AND ITS DISEASES.

PROLETARIATE, prō-lē-tā'rĭ-āt, a general term applied to those Roman cities who stood in the sixth class, possessing less than 1,500 asses, or nothing at all. They were ever afterward distinguished by the name of *capite censi*, apparently because they were taxed only by head. The term has been revived in modern times as a designation of the lowest class of the community who possess no capital and is frequently used in socialistic literature. Consult Broda, R., and Deutsch, I., 'Das Moderne Proletariat' (Berlin 1910); Crapsey, A. S., 'The Rise of the Working Class' (New York 1914); Gongenot des Mousseaux, H. R., 'Des Proletaires, etc.' (Paris 1846); Halbwachs, M., 'La Class Ouvrière les Niveaux de Vie' (Paris 1913); Huber, J., 'Des Proletarier' (Munich 1865); Kampfmeyer, P., 'Das Moderne Proletariat' (in 'Moderne Zeitfrozen,' No. 12, Berlin n. d.); Kantsky, K., 'The Working Class' (translated by D. De Leon, New York 1911); McCarthy, J. P., 'The Rise of Dennis Hathnaught' (Brooklyn 1915); Magnon, F., 'Etudes Sociales' (Paris 1913); Proudhon, P. J., 'De la Capacité Politique des Classes Ouvrières' (Paris 1865); Simon, J. F. S., 'L'Ouvrières' (Paris 1861); Sombart, W., 'Das Proletariat' (Frankfurt 1906); Villard, A., 'Histoire du Prolétariat Ancien et Moderne' (Paris 1882).

PROLOGUE, in dramatic poetry, (1) in the Greek drama, that part of a tragedy preceding the first appearance of the chorus. (2) In the Roman and English drama, an address to the audience preceding the piece itself. It may be either in prose or verse, and is usually pronounced by one person. Among the Romans the player who delivered this address was called the *prologus*, and usually considered as a person of the drama. Thus in the 'Amphitryon' of Plautus (q.v.) Mercury appears as *prologus*. Prologues sometimes relate to the drama itself, and serve to explain to the audience some circumstances of the action, sometimes to the situation in which the author or actor stands to the public, and sometimes have no immediate connection with either of these persons or subjects. Shakespeare makes use of the prologue, as in 'Henry V' and the Restoration drama almost invariably employed it. Amongst other famous dramatists who have used the prologue may be mentioned Goethe, Schiller, Molière, Racine, Ben Jonson and Dryden. It long since fell into disuse, but is occasionally revived for the effect of quaintness. Consult Archer, W., 'Play Making' (London 1912); B. G. S., 'A Study of the Prologue and Epilogue in English Literature from Shakespeare to Dryden' (London 1884); Dryden, J., 'Dramatic Pœsie' (in 'Essays,' Vol. I, Oxford 1900); Freytag, G., 'Technique of the Drama' (Chicago 1908); Griffith, A. F., ed., 'A Collection and Selection of English Prologues and Epilogues from Shakespeare to Barrick' (4 vols., London 1779); Matthews, Brander, 'A Study of the Drama,' (New York 1910); Schlag, H., 'Das Drama' (Essen 1909); Schlegel, A. W. von, 'A Course of Lectures on Dramatic Art and Literature' (2 vols., London 1846).

PROME, prŏm, India, (1) a town of Lower Burma, capital of a district of the same name, on the Irrawaddy, about 160 miles north of Rangoon by rail. It is a large town surrounded by a wall, with extensive suburbs; owing to the flat ground on which it is built it is subject to inundations from the river. It has silk-weaving, lacquer and other industries, and exports silk, rice, cotton, etc. On one of the many hills near the town stands the Schwe-Tsan-daw Pagoda, one of the most famous pagodas of India. Pop. about 30,000. (2) The district has an area of 2,914 square miles, and a pop. about 375,000. In ancient times there was a kingdom of Prome which is known to have flourished for many years, but regarding the history of which next to nothing is known now. At the end of the Second Burmese War in 1853, Prome together with the balance of the province of Pegu became British territory. Consult Beylie, L. M. E. de, 'Prome et Samara, Voyage Archéologique en Birmanie et en Mesopotamie' (in *Société Francaise des Fouilles Archéologiques. Publications*, No. 1, Paris 1907).

PROMESSI SPOSI, I, prō-mĕs'sē spō'zē ē, an Italian romance by Alessandro Manzoni (q.v.), written between 1821 and 1825 and published in Milan in 1827, dealing with Milan under the Spanish rule of the 17th century. In fidelity to life, the interest of its principal characters and the beauty and truth of its descriptions, it stands as the greatest Italian historical romance, and its author as the creator of a school of historical novelists. A revised edition was published in 1842. Many other editions have been published since then, the best being that prepared by P. Bellezza (Milan 1908). A condensed edition was brought out by J. Geddes and E. H. Wilkins (Boston 1911). It has been translated widely, the best English translations having been published as part of 'Bohn's Novelists' Library' (London 1883) and 'Collier's Harvard Classics' (New York 1909). A number of dramatizations of the story have been made, none of them, however, approaching in importance the original. Consult D'Ovidio, F., 'Le Correzioni ai Promessi Sposi e la Questione della Lingue' (Naples 1895); Holland, R. S., 'Builders of United Italy' (New York 1908); Howells, W. D., 'Modern Italian Poets' (New York 1887); Negri, G., 'Sui Promessi Sposi di Alessandro Manzoni' (Milan 1903–06).

PROMETHEUS, prō-mē'thūs, in Greek mythology, son of Iapetus the Titan and Clymene (according to Hesiod), or Themis (according to Æschylus), or Asia (according to Apollodorus). He is the legendary giver of fire and all its benefits to men. In Athens Promethus had an altar in the academy and a special festival was devoted to him. Hesiod and Æschylus (q.v.), the latter of whom made his story the subject of a trilogy of which one tragedy, 'Prometheus Bound' (q.v.), is alone extant as a whole, are our chief authority for the myth concerning Prometheus. He is represented as the brother of Atlas, Menœtius and Epimetheus. According to Æschylus, Prometheus took part with Zeus against his brother Titans and by his craft and sage counsel rendered Zeus victor and enabled him to ascend his father's throne. Later, objecting to the plan of Zeus to destroy mankind and create a new generation of beings, he helps the weak race of mortals by stealing fire from the lightnings of Zeus and giving it in a hollow reed to men, to whom it had been till then denied. In revenge Zeus has Prometheus chained to a rock in the Caucasus by Hephæstus and his helpers Kratos and Bia, and sends a vulture to tear forever at his vitals, not allowing him to end his pain by death. Steadfastly Prometheus bears his doom, aware that in time Zeus will fall by the hand of a son born to himself and Thetis. Heracles, with the consent of Zeus, slays the vulture and releases Prometheus, who returns to Olympus and thereafter is the wise counsellor of the gods. It is in the above form that the myth has been most generally accepted, but it was varied in many ways by different poets and philosophic interpreters. His Greek name, meaning "Forethought" (that of his brother Epimetheus, signifying "Afterthought"), makes the underlying allegory apparent. Prometheus, as the friend of men, the wise helper in necessity, and in some interpretations as a rebel against unjust authority, has been much referred to in literature, and in modern times was made the subject of Shelley's lyrical drama 'Prometheus Unbound,' and of the fragment of a tragedy by Goethe. He has also been frequently represented in plastic art. The most famous English rendition of Æschylus' tragedy is Mrs. Browning's 'Prometheus Bound.' Another more recent translation has been published by R. Whitelaw (Oxford 1907).

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PROMETHEUS BOUND, The, of Æschylus, has been called «the most sublime poem in the world.» Macaulay declares that by the principles of dramatic writing we shall instantly condemn, but if we think only of the poetry we must admit that it has never been surpassed in energy and magnificence.

The chief character comes from a remote past. Æschylus was merely the conscious artist that gives the impressive figure final and immortal form. The play is the perfect type of the primitive tragedy, which Aristotle designated «simple.» It has one feature possessed by no other tragedy; it transports us to a marvelous and fantastic sphere, to the most primitive period in the history of the world. The god that seeks to elevate man, that gives him the light of understanding, engrosses our attention. From the beginning to the end of the play the illusion is not broken. A god suffering for humanity is before our eyes; deities live and move in visible presence.

Zeus desired to create a new race after his own design. He was not satisfied with ephemeral man, a creation of the crude Titan world. But Prometheus, pierced by our human miseries, champions the old race: he steals fire from heaven and teaches the arts to insensate creatures. But Zeus will brook no infringement of his laws and resolves to punish the recalcitrant. So he commissions his two satellites, Might and Force, to drag the rebel to a steep rock in Scythia, «whose rugged brows are bent upon the swelling main.» Here the play begins.

Unfeeling Might turns the criminal over to Hephæstus, the smith, who clamps Prometheus to the cliff, where he will never see a human form: broiled by the sun's bright flame, he will welcome the spangled-robed night, and again the sun as it breaks the hoar-frost of the morn. Prometheus bears the taunts of Might in silence. Then the Titan invokes inanimate nature to witness the intolerable indignity to which he has been subjected: the divine æther, the rivers, the innumerable laughter of the sea-waves, Mother Earth and the bright circle of the all-seeing Sun. Suddenly a rush of wings is heard and a troop of sea nymphs enter in a winged car — «maidens yet rosed over with the virgin crimson of modesty.» Prometheus appeals to their pity. They remind him that a new pilot is at the helm in Olympus. The Titan swears that he will do something yet, when times are ripe, to this raw, unthankful king. Exultantly he cries that threats will not make him cringe. Weak women that they are, replete with tenderness, the Oceanids cannot understand how one can dare resist the will of Zeus. They beg Prometheus to unfold his story. One faction of the deities determined to cast out Cronus and set up Zeus as their king. By the help of the resourceful Prometheus, Zeus gained the throne. But the new ruler did not give his supporter the recompense deserved. He resolved even to annihilate the human race. Prometheus alone opposed the sovereign. The sympathizing nymphs now exhort the sufferer to seek some release. They alight from the car to hear the details of the Titan's story, when their father, Oceanus, enters astride a winged horse. The old man of the sea remonstrates with his kinsman and bids him beg for pardon. But the Titan, like Satan, hardens in his strength.

From this homely scene Æschylus soars aloft to a height of poetry as beautiful as it is magnificent. The whole world makes moan: the daughters of Colchis, the Scythian hordes, Asia's martial glory, the surge of the sea, Hades in the abyss of the earth, and all the streams murmur and sigh in a pathos of woe. Prometheus then enumerates the benefits he has conferred on man: reason, house-building, taming of beasts, science, literature, mathematics, astronomy, navigation, medicine, divination, mining. The chorus admonish him that all these gifts were for naught, since weak, ephemeral man could not help him in return. Io enters. The only mark of her metamorphosis is her horns. In admirable verses the poet depicts her fatigue, her despair and the tender sympathy she manifests at the sight of the sufferer bound on the storm-beaten rock. Prometheus tells her that he recognizes the daughter of Inachus, who had set Jove afire with love and is now by vengeful Hera driven o'er the earth. In a melodiously plaintive narrative, full of charm and grace, Io relates how phantasms and dreams came to her at night and reached the organ of her fancy, urged her to go out to the meadow-land that Zeus might be lightened of his passion; how her father had driven her forth from home; and now by gadfly sharply stung, pursued by the immitigable Argus, «with frantic bound from land to land I fly.» Prometheus now tells the harassed maiden that she must traverse Europe, through a wild and dangerous country, to the Tauric Chersonese, cross the Thracian Bosporus to Asia and then proceed to the plains of Cisthene, where the Gorgons dwell, and to the land of the griffins and Arimaspians, through a region peopled by monsters. At last she will come to a far land, whence she must creep down the river Aethiops until she comes to the Delta. There in the city of Canobis Zeus will restore her to her pristine form with but the touch and gentle pressure of his hand; and she will bear a son, swarthy Touchborn, who is to rule over all the land watered by the Nile. In the fifth generation 50 maidens, fleeing the proffered marriage of their cousins, shall return to her home in Argos and shall in the watches of the night put their lords to death. But one of the maidens will spare her mate. From this pair will spring a royal race, one of whose descendants is destined to deliver Prometheus. With a cry of terror the demented Io darts away, and the chorus moralize on the inadvisability of unequal matches. A great change has now come over the Titan. He is reminded by the appearance of Io that he will find respite; and so he resolves to await the retributive hour. The æons which he contemplated a moment ago seem now but a pulse beat. The steadfastness with which he asserts his will in the face of disaster makes an impression of unusual grandeur. «Let him in calm assurance seat him sure, fixing his faith on the deafening crash reverberating in the sky, and holding in his hand the thunder-stone high poised. He shall find a flame more furious far than the livid lightning's flash, a deafening crash to drown the thunder's roar!» The chorus are horrified. They remind the Titan that those who bow down to Necessity are wise. He replies: «Cringe low, crook the knee, truckle to the ruler ever. Fawn upon Zeus, and if you will, but think not that I care aught for him. Homage may he have from all, but none from me.»

Heaven's winged herald, Hermes, now sails downward on the bosom of the air. He commands Prometheus to yield up his secret. But the Titan observes the menial of the new crowned king with some surprise and thrice as much disdain: Zeus shall soon know that the victim holds a power above his oppressor: «Let him hurl his red levin and with storms and subterranean shocks of thunder confound the universe — never will he be able to extort the secret by any pain or ignominy he may devise.» Deaf to all entreaties, Prometheus will never sue for grace or bend the suppliant knee, never implore the hated king with base spaniel fawning and womanish supplication of hands. Hermes replies that Zeus will smite the rock with a thunderbolt and hurl the prisoner down into the yawning chasm of the earth, and after a long sweep of time the Titan will come forth to the light again only to have his body torn to a shred by the winged hound of Zeus, the ravening eagle, which will cram his crop full on the captive's liver. The nymphs urge the obdurate god to yield, but their entreaties are vain: «Let the forked curl of flame be hurled upon my head, heaven and earth convulsed with thunder and quivering spasm of winds exasperate; let the billow of the deep with its boisterous surge confound the paths of the stars in the sky, let him hurl me into the vortices of necessity — he cannot destroy me.» Hermes soars aloft. A storm breaks. The ocean swells and foams, all the sway of earth shakes like a thing unfirm, thunder subterrane reverberates, fiery-zigzag flashes gleam, whirlwinds twirl the dust, the winds leap together in conflicting blasts and the threat of Hermes goes into sublime fulfilment.

The second play of the trilogy was the ‹Prometheus Unbound.› The Titan reappears bound to the same rock, but on the Caucasus. The other Titans, now released from Tartarus, urge Prometheus to yield. The eagle has been glutting his maw on the captive's liver every thing unfirm, thunder subterrane reverberates, with his arrow. Mutual concessions are made, and Prometheus returns to his place among the gods in Olympus.

The third play was called ‹Prometheus, the Fire Bearer.› The theme was doubtless the induction of Prometheus into his high office as an Attic god and the establishment of a festival, the *Prometheia*, a prominent feature of which was a torch-race.

Without fire there would be no art, no industry, no civilization. Fire humanized man. The earth-fire came from the heaven-fire. To primitive man the production of fire was a miracle — in volcanic countries subterranean, in others super-terrestrial. Among all nations there is a tradition that fire was stolen, either directly from the gods or from some other tribe on whom the gods had bestowed the blessing. These myths closely resemble one another — in New Zealand, North America, Greece, France, India. Five hundred of the 1,000 Rig-Veda hymns invoke Agni (Ignis) a common surname of whom is Pramati (Prometheus, Forethought). Among savages the thief is usually an animal, among barbarous races, a man, among civilized nations, a god, or demi-god. The myth of the Fire-Stealer is the most popular of all among the aborigines of the Northwest. In Greece the legend goes back to the oldest period of mythology. Hesiod conceived the condition of man in the primitive period as a happy one. Prometheus brings punishment on himself and troubles on mankind, whose cause he has espoused. Zeus sends Pandora, whose charms mortals cannot resist. The conception of Æschylus is higher than that of Hesiod. The tragic poet insists on the benefit of the gift, and shows how fire was really the starting point of civilization, how all human culture had its origin in the spark which Prometheus filched for us in the fennel stalk. Primitive man was plunged in a heavy stupor, but in his beast-nature was capability. Prometheus taught him every art and science. The Titan's greatest crime was

" To render with his precepts less
The sum of human wretchedness,
And strengthen man with his own mind."

so that the pining sons of earth uplifted their prostrate brows from the polluting dust.

Joseph E. Harry,
Author of ‹The Greek Tragic Poets,› etc.

PROMETHEUS UNBOUND: A Lyrical Drama is the greatest of Shelley's longer poems. «This poem, begun in the autumn of 1818, was chiefly written,» says Shelley, «in the mountainous ruins of the Baths of Caracalla. . . . The bright blue sky of Rome and the effect of the vigorous awakening spring in that divinest climate, and the new life with which it drenches the spirits even to intoxication, were the inspiration of this drama.» This was his first experience of an Italian spring, and the reawakening of nature gave impulse and imagery to a vision of the rebirth of justice and happiness, on which the poet often fondly dwelt. «That man could be so perfectionized,» Mrs. Shelley notes, «as to be able to expel evil from his own nature and from the greater part of creation, was the cardinal part of his system.» The drama depicts this process in symbolism borrowed from a Greek myth already dramatized by Æschylus in the ‹Prometheus Bound.› In the Saturnian Age — or, as Rousseau would say, in a state of nature — men were innocent and happy. Prometheus gave them the arts of life — institutions social and political; these, however, growing obsolete, cramped progress, begot abuses, yet acquired a prescriptive authority which became tyranny. This prescriptive authority — to Shelley, the very principle of evil — is in the poem identified with Jupiter, the persecutor of Prometheus. The latter represents goodness, wisdom, progress. Act I reveals him in his agonies; these result from contemplating the world as it is, especially when evil originates from intended good (e.g., see the view of Christianity, ll, 107 ff.). The struggle against evil enthroned has hitherto failed because hatred and violence have been the weapons of revolt (so in the French Revolution, ll, 567 ff). Only when wisdom, abjuring hate, follows the dictates of love will the Golden Age return,— i.e., in the allegory, when Prometheus is united to the nymph Asia. Asia, like the other symbols, has varying significance; she is love, or the emotional nature; again, she is that ideal spirit to whom is addressed the «Hymn to Intellectual Beauty,» and who in the «Adonais» is called

Urania. The central figure of Act II, she seeks for truth, which she finally attains by the aid of Demogorgon. This mysterious personage perhaps symbolizes destiny as the result of law, or the fundamental constitution of the universe; the emotional nature penetrates to and accepts the ultimate truth. As Act I depicts the patient endurance which is the present lot of goodness, so Act II depicts future progress toward a true philosophy. When wisdom is wholly dominated by love, and love accepts truth, the consummation of things is at hand. In Act III the dénouement follows; Jupiter weds Thetis,— a union from which he expects some culminating advantage; instead, Demogorgon appears and drags him to the abyss. Prometheus is set free and united to Asia. The intellect having attained its ideal, the emotional nature being centred on the true, «the Golden Years return.» This act concludes with a description of redeemed humanity. Act IV (an after-thought written at the close of 1819), is wholly lyrical, and reveals universal nature joying in a regenerate world. «No modern poet,» says Professor Herford, «has come nearer making the morning stars sing together.» Act IV is a crowning example of tensity of emotion, tenuity of thought and poetic beauty. «The passages which are most thoroughly stripped of doctrine, of definite ideas, and even of humanity, are the most perfect of all, and Shelley is there most himself» (Elton).

This meagre outline, bare of all the beauty and passion of Shelley's poetry, is ludicrously incapable of suggesting the original. «Prometheus,» while in some measure modeled on Æschylus, is, unlike it,— «a lyrical drama,» an allegorical presentation of thoughts and feelings. It has no characterization, save perhaps in the hero, nor any plot interest; such action as it has is difficult to follow. Its merits are of another order, and may be indicated in the words of William Rossetti: «There is, I suppose, no poem comparable, in the fair sense of the word, to 'Prometheus Unbound.' The immense scale and boundless scope of the conception; the marble majesty and extramundane passions of the personages; the sublimity of ethical aspiration; the radiance of ideal and poetic beauty which saturates every phase of the subject, and almost, as it were, wraps it from sight at times, and transforms it out of sense into spirit; the rolling river of great sound and lyrical rapture; form a combination not to be matched elsewhere, and scarcely to encounter competition.» Consult Mrs. Shelley's Notes; Wm. Rossetti's paper in Shelley Society's Publications, 1886; Todhunter's Study of Shelley; Miss Vida Scudder's annotated edition.

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PROMISE, an engagement entered into by one person to perform or not to perform some particular thing. When there is a mutual promise between two parties it is termed a contract. A promise may either be verbal or written. See CONTRACT.

PROMISE, Breach of. See BREACH.

PROMISSORY NOTE, is an unconditional promise in writing for the payment of money in a sum certain, absolutely, and at all events; it is negotiable when it is transferable from one person to another by endorsement or delivery, so as to vest in the party taking it the legal title to the note and to the property it represents; they are of ancient origin and were in use by the Romans. Under the law, generally, notes are assignable, so that the assignee may bring an action thereon in his own name. The usual parties to a promissory note are the drawer, the payee to whom it is drawn and the endorser. The important characteristic of a negotiable note is that the person receiving it does so for value and without notice of any question of title of the previous holder. Anything on the face of a note sufficient to put a transferee upon inquiry subjects him to any defenses between all the original parties; one taking negotiable paper that is overdue does so under like conditions. Possession of a negotiable note which is payable to drawer, or which is endorsed in blank, or to the holder specially, is presumed to be legal in every respect. A note to which any signature is attached, through which the holder claims, that has been forged, is not good. The holder of a note can bring an action thereon, except that it is payable to another, especially a note endorsed in blank. If a note is made subject to any conditions as to demand or notice, same must be first complied with before action can be brought. Protesting of a note is the declaration by the holder against any loss on account of non-payment; its object is to give notice to the endorsers of their consequent liability; such notice is essential, and it is customary that protest be made by a notary public. Many important subjects in relation to the laws governing promissory notes are the subject of statutes, which differ in various jurisdictions. See also ENDORSEMENT; NEGOTIABLE PAPER; NOTE.

PROMOTER, *in law,* (1) one who promotes an undertaking or the like, as a corporation. In this sense the term is applied specifically to one who aids in the organization of a joint-stock company or corporation or (in Great Britain) to one who aids in the passage of an act of Parliament. In the United States it is used almost exclusively in the sense of one who aids in the organization of a corporation by soliciting subscriptions to its stock, planning its business operations and doing other similar acts in furtherance of that object. A promoter in this sense is held by law to act in the relation of a trustee to such corporation, is held strictly answerable for any fraudulent misrepresentations which he makes to intending investors and is precluded from taking a secret advantage over the other stockholders. A promoter is personally liable on contracts made by him for the intended company after its failure to incorporate and also for subscriptions paid into such a company. A promoter is not allowed secret profits as between himself and the corporation, but he may purchase property for the corporation and later sell it at an enhanced price. (2) One who prosecutes offenders in an ecclesiastical court.

PRONGBUCK, or PRONGHORN, the American pronghorned goat-antelope (*Antilocapra americana*), one of the two sole living representatives on the American continent of the large series of Old World antelopes (*Bovidæ*), the other being the Rocky Mountain goat (*Oreamnos montanus*), which is more nearly a true antelope than a goat. Although almost universally known as «antelope,» the pronghorn differs so greatly from the true antelopes that it is made the type of a distinct family (*Antilocapridæ*), having affinities alike with the giraffes, deer and goats. The horns, while resembling those of the true antelopes and the *Bovidæ* generally in consisting of a bone-core covered by a horny sheath, differ from those of all *Bovidæ* in the presence of a short anterior spur or branch. Furthermore, they are more or less densely and extensively covered with hair, thus resembling the horns of the giraffe. But by far the most remarkable peculiarity of these horns is that they are shed annually like a deer's antlers. So skeptical were zoologists as to the possibility of a hollow-horned ruminant shedding its horns, that, although the fact was known to hunters for many years and had been repeatedly reported, it was not until 1865 to 1868 that the truth of these reports became fully established. The entire horn is not shed as in the case of deer, but only the horny sheath, the bony core remaining intact and permanent and its epidermal covering immediately beginning to regenerate a new horn.

The pronghorn is about three feet high and five feet long, with a very short tail, slender legs, pointed, erect ears and extremely large eyes. Two important characteristics are the absence of the small accessory hoofs from both fore and hind feet and the hairiness of the end of the muzzle except along a narrow median line. The color is a variable and somewhat mottled brown, with a chestnut colored mane and a brilliant white rump patch or so-called recognition mark. Both sexes have horns; but those of the female and young are smaller and simple. Since the disappearance of the bison, the prongbuck is the most characteristic ruminant animal of the great Western plains. Although the progress of settlement has much diminished its numbers and reduced the limits of its range both easterly and westerly, the prongbuck still holds its own over an area extending for about 30 degrees from Saskatchewan on the north to the Mexican state of Zacatecas on the south, and from the Dakotas and Kansas westward through the Rocky Mountains and in the Cascades into Oregon. It occurs in Arizona and at a few points in California, but is absent from large areas in Colorado, Utah, New Mexico and Arizona. Prongbucks live in bands on the open plains or in the hilly countries; bucks, does and fawns associating during the greater part of the year, but at the close of the gestation period, which varies from March to September, according to latitude, the pregnant does separate to drop their two fawns in solitude, and the old bucks wander into the wooded hills. Their natural food consists almost entirely of grass, though grain, apples, etc., will be eaten in captivity. They are wonderfully alert animals, with keen senses, and so timid that they retreat on the slightest alarm, but withal so curious that they soon pause to gaze at the cause of their alarm. Their speed is marvelous, and their bounds of tremendous extent, but their power of endurance is not great and they never leap over an obstacle of any height. They may be domesticated with comparative ease and sometimes breed in captivity; and it is said that a fence of only three or four feet high is quite sufficient to confine them. Owing to the excellence of their flesh, though it is rather dry, and their splendid game qualities, they are much sought by hunters. The methods most in vogue are coursing with grey or deer hounds, running with relays of horses, and stalking, the latter especially requiring much skill, though they may be lured toward the concealed hunter by an appeal, by means of a fluttering colored cloth or handkerchief, to their inordinate curiosity. The Indians hunted them by stalking, sometimes dressed in the skin of one of their kind; by driving them into brush enclosures, over which they would not leap; and in other ways. Consult Canfield (in ‹Proceedings of the Zoological Society,› London 1866); Caton, ‹Antelope and Deer of America› (Boston 1881); Lyddeker, Richard, ‹Royal Natural History› (Vol. I, London 1895); Roosevelt, Theodore, ‹American Big Game Hunting› (New York 1901) and ‹The Deer Family› (New York 1902); Seton, E. T., ‹Life Histories of Northern Animals› (ib. 1909).

PRONOUN, a part of speech which takes the place of the noun, to avoid too frequent repetition of the noun or to designate an object whose name is not known or, if known, is not desirable or available for use. Pronouns have the same properties as nouns, viz.: gender, person, number and case. It differs from the noun in this, that whereas the noun stands always for some definite object or concept or class of concepts, for example, Chicago, man, house, the pronoun may stand now for a given concept or class of concepts; but again for a totally different one; thus the pronoun has no fixed denotation: «it» may stand for «Chicago,» or «horse,» or «universe.» A usual classification of pronouns divides them into those personal (I, thou, he, she, it); demonstrative (this, that), interrogative (who? which? what?), possessive (my, thy, his, her, hers, its, our, ours, your, yours, their, theirs), relative (who, what, which, that), and indefinite (any, aught, some, each, every, other, etc.): but the demonstratives and the indefinites do not, as a rule, fall under the definition of pronoun. Worthy of note is the general going out of use (at least in polite society when equals address equals) in all modern languages, of the personal pronoun (and its possessive) of the second person singular, thou, thy, thine and the substitution for it of the second person plural or (in German) the third person plural or of a form signifying «your worship» or the like. Consult Amyot, C. J. B., ‹De la Nature des Pronouns› (Paris 1856); Goebel, K., ‹Die Grammatischen Kategorien› (in *Neue Jahrb. für das Klassische Altertum Geschichte, und Deutsche Literatur*, Series III, Vol. V, Leipzig 1910); La Grasserie, D. de, ‹De la Veritable Nature du Pronoun› (in ‹Etudes de Grammaire Compare,› Louvain 1888); Maetzner, E., ‹An English Grammar› (3 vols., London 1874); Owen, E. T., ‹A Revision of the Pronouns› (in Wisconsin Academy of Sciences, Arts and Letters, Translations, Vol. XIII, p. 1, Madison 1901).

PRONUNCIAMENTO, in Spanish-speaking countries, especially in Spanish-American republics a proclamation against the existing government, intended to serve as a signal of revolt. The word *contrepronunciamento*, that is, counterproclamation, also occurs.

PRONUNCIATION, the act of uttering words or articulate sounds of the voice. The alphabetic characters are designed to represent with more or less precision the voice-sounds of a language, and if all those sounds have each its proper sign, a written word will be a sure index of its pronunciation. The alphabet of the Spanish language is nearly perfect in this respect. In Spanish the vowels have each one quality of sound: in whatever situation, they have each but one value and *a*, *e*, *i*, *o* and *u* are pronounced respectively as *a* in father, *ei* in rein, *ee* in see, *o* in lone and *oo* in moon. The consonants, too, have only one sound, except that before the vowels *a*, *o* and *u* and before consonants, *c* has the sound of *k* and *g* the hard sound of *g* in get; also, to represent special sounds, *l* is doubled (*lleno*, pron. lyaino) or a diacritical mark is used (*año*, pron. ahnyo). Not so in English. In English each of the vowel and consonant signs designates various sounds. Thus the vowel sign *a* denotes at least six different vowel sounds; *e* at least four; *i* at least three; *o* (including *oo*) seven and *u* in four; often they are silent, representing no sound. Many of the consonants, too, though not to the same extent as the vowels, represent each, whether singly or compounded, two or more different sounds; examples: cede, call, child, machine, chemic. Other consonants which stand for more than one sound are *s* (sat, has, sure), *t* (tan, thin, thine, nation), *n* (sin, sing), etc.

The different sounds represented by the vowel sign *a* are: (1) the short vowel sound which it oftenest represents: it is heard in man, cab; this sound is almost peculiar to English; it differs slightly from the short *a* of French and considerably from the short *a* of German; Germans who are beginning to learn English have difficulty at first in producing this English vowel and instead of man say men, het instead of hat. (2) The long sound of *a* as in hate, late; its sound is that represented in other languages by the second vowel *e*; in German and other languages the sound of the word bane would be represented by ben or behn or bên, etc. (3) The sound of *a* (however represented — by *a*, or *ei*, or *ea*, etc.) — before *r* in the same syllable, as in share, bear. A vulgar mispronunciation of such words is shar, bar; in Irish pronunciation the *a* in share, bear, pear, etc., has precisely the same sound as in shape, lane, bane. (4) The sound of *a* in father, calm, far: this is usually styled the Italian sound of *a*. (5) The sound of *a* in ask, branch, pass, differing from the pronunciation of the same letter in at, tan, pan: it is the short sound of the *a* in father. In England and New England the distinction is made between the sound of *a* in branch, ask, etc., and the *a* in barn, ran; elsewhere in the United States it is not observed. (6) The sound of *a* in all, warm, talk, is peculiar to English; it is much broader than *a* in German words all, fall. (7) The sound of *a* in what, wander, is peculiar to English; it is represented by *o* in not, gone, etc. The sounds of *e* are (1) its short sound as in net, sent; (2) the long sound as in obese. mete, green; this sound is represented in most other languages by the third vowel *i*; (3) the sound which it has in vein, rein; in other languages this is the primary sound of this vowel; (4) the sound, peculiar to English, which it has before the letter *r* as in per, confer. Three sounds are represented by *i*; namely: (1) the short sound as in pin, bin; (2) the corresponding long sound as in marine: this is the regular sound of *i* in other languages; in English *i* is so sounded only in a few words; (3) the long sound heard in pine, ride: this is a diphthong and equal to *ei* or *ai*. The vowel *o* represents the following sounds: (1) Its primary sound in English and other languages, as in ode, lone; (2) a short sound peculiar to English, as in not, nod: this is not the *o* of ode shortened; the shortened *o* of ode is unknown in English; (3) the obscure short sound (same as that of *u* in but) heard in other, son, done; (4) the sound heard in prove, move: this is the long vowel *u* of German, Spanish, etc., and the *ou* of French; (5) the same sound shortened, as in wool, book, took; (6) a sound closely resembling that of *a* in all: it occurs when *o* is followed by *r* in the same syllable, as in order, corner; in Irish pronunciation this *o* has the same sound as *a* in all. The sounds represented by *u* are: (1) that heard in rule, rumor, Lucifer: here it is equal to oo in moon, and it represents the sound of *u* in German, Spanish, Italian, etc., but not in French; (2) the corresponding short sound heard in put, bull; (3) the peculiar sound given it before *r* in the same syllable, as in urge, urn; (4) the diphthongal sound that it has in union, pure: here it is equal to *yu* or *eu*. In the United States long *u* after *l* has always the sound of *oo* in ooze; but dictionaries which represent the pronunciation of such words as lurid, luce, in England, give to the *u* the same value it has in cure, that is, the diphthongal sound (l'yurid, l'yuce), though in the same dictionaries the *u* in luna, lunary, ludicrous, etc., is represented the same as in rule. In the United States the *u* in such words as duty, tulip, is commonly mispronounced as dooty, toolip, instead of d'yuty, tyulip; the Irish mispronunciation of such words is jooty, tshoolip.

In the pronunciation of various consonants English is peculiar or differs from other languages in sundry respects; for example, *ch* in English words is equal to *tsh* (chat) or to *sh* (chivalry) or to *k* (chemism). The *d* and *t* of English are pronounced with the tip of the tongue touching the gums well above the teeth; in other languages the contact is at the roots of the teeth. The *th* in thin is almost peculiar to English, but the same sound exists in Spanish; the sound of *th* in thy, that, is peculiar to English. In Irish pronunciation the sound of *th* in thank, thousand, is produced by firm contact of the end of the tongue with the teeth and forcible emission of the breath. In the Irish pronunciation of thy, that, there is also contact of the tongue with the teeth and gums. For the value of the letters and their combinations in other languages see the articles on these languages and consult the works referred to under these heads. Consult also Bloomfield, Leonard, 'Introduction to the Study of Language' (New York 1914); Passy, Paul, 'Petite phonétique comparée des principales langues européennes' (2d ed., Leipzig 1912); Soames, Laura, 'Introduction to English, French and German Phonetics' (3d ed., London 1913); Viëtor, T. W., 'Elements der Phonetik des

Deutschen, Englischen und Französischen' (6th ed., Leipzig 1914). See ACCENTS.

PRONY, prō-nē, **Gaspard Clair François Marie Riche**, BARON DE, French engineer: b. Chamelet, Rhone, 22 July 1755; d. Asnières, Seine, 29 July 1839. He received his technical education at the Ecole des Ponts et Chaussées. As assistant to the civil engineer Perronet he was employed in building the bridge De la Concorde at Paris and the restoration of the harbor of Dunkirk. Made head of the board of survey, in 1791 he superintended the construction of new trigonometrical tables, extended to 25 decimal places, necessitated by the establishment of the metric system. This great work in 17 volumes is preserved in manuscript at the Observatory at Paris. In 1794 he was appointed director-general of bridges and roads and at the same time was made professor of mathematics at the Polytechnic School, in 1795 he became a member of the Institute and in 1798 director of the Ecole des Ponts et Chaussées. Under Napoleon he executed improvements in the harbor of Genoa, Ancona and Venice and in the navigation of the Po. In 1810 he became a member of the commission charged with the drainage and improvement of the Pontine Marshes. In 1818 he was made one of the 50 foreign members of the Royal Society and in 1835 a peer of France. He wrote several works of a technical character connected with the engineering operations of which he had charge, the most important of which is 'Déscription Hydrographique et Historique des Marais Pontins' (2 vols., Paris 1822–23). He also published 'Nouvelle Architecture Hydraulique' (2 vols., Paris 1790–96); 'Viede Pingré' (Paris 1796); 'Nécanique Philosophique' (Paris 1800); 'Leçons de Mécanique Analytique' (2 vols., Paris 1810–15).

PROOF. See EVIDENCE.

PROOF IN ART, the name given to an impression of an engraving "pulled" or struck off, from the plate, with or without the signature of the artist. After the various "proofs" and "states," there comes, finally, the "finished" or "publication state," preceded by the last proof passed by the artist as "ready for printing." Each of the impressions issued to the public is classed under one of the following headings: (1) Artist's proofs; (2) proofs before letters; (3) lettered proofs (or proofs after letters), and (4) prints. These headings do not necessarily correspond with "states" of a plate. They are simply description of the amount of lettering printed on the impressions to which they refer. The "publication line" should be on every impression and is the only lettering which appears on artist's proofs. Proofs before letters have printed on them the names of the artist and engraver of the work, in addition to the "publication line," but they are without the title. They are stamped on the right.

Lettered proofs have printed on them the names of the artist and engraver of the work and the title of the subject. They are also stamped on the right. Prints have all the above-mentioned printing, but the style in which the title is printed is altered in some manner from that appearing on the proofs. They are not stamped at all. To-day artists who "pull" their own proofs usually sign in pencil.

A "wax proof" is a tentative proof by the engraver for the purpose of learning what retouching may be necessary. It is obtained by filling in the lines with lampblack and applying it to a sheet of paper coated with white wax and exerting upon it a gentle pressure with a burnisher.

"Proof with gray letter" is applied to proofs in which the lettering is grilled with "hatchings" (small lines).

"Proof with white letter" is a proof in which the characters of the legend or inscription are only indicated by outlines.

"The word 'state' and 'proof,' writes Dr. Frank Weitenkampf, 'call for explanation.' Their use is not always well defined. In a general way it may be said that the 'proof' is usually applied to an impression taken from the plate in the earlier clearly unfinished stages, while 'state' is used to indicate stages of relative completeness. As the engraver, or etcher, works on his plate, he takes an impression occasionally to get the effect of what he has done. Such impressions are known as 'trial-proofs' or 'working-proofs.' There are many ways of making changes. Work on copperplates may be obliterated by scraper and burnisher or the plate may be beaten up from the back on an anvil by a hammer. A portion of a wood block may be cut out and a plug of wood inserted in its place to be re-engraved. A piece may even be added to an engraved block or plate and the engraving then enlarged. Occasionally an etcher will try his point on the margin of the plate or even execute some slight sketch. Chodowiecki did this; Buhot did it to a very elaborate extent. Such marginal sketches are called 'remarques.' And from this habit originated the systematic production of 'remarque proofs' against which Whistler directed his fine sarcasm. But he also declaimed vigorously against the presence of any margin at all. A margin on the plate is not a necessity, but a proper amount of margin is undoubtedly a protection for a print. In modern times the whole matter of 'proofs' and 'states' was brought into a regular system, impressive to the buyer and profitable to the producer. There may be, for example, successively trial proofs, finished proof, proof with remarque, artist's proofs, before all letters (or inscription), 'state' with names of artist only, with inscription, in open letters, with letters filled or solid, with publishers' address. And the 'states' again may be on India or Japan paper and on plain paper.

"The importance of a good impression is paramount and the good impression is the result of the printer's skill and the 'state' of the plate. For this reason, also, early 'states' are sought by collectors, but even more, perhaps, because they are rare. For rarity plays a very important part in the collector's list of reasons. In reality, mere priority of 'state' does not mean much in itself. The very fact that the artist thought it necessary to create a later 'state' by making corrections or additions, is significant. Such an afterthought may raise a plate from comparative insignificance to telling force or it may spoil it altogether. Turner's 'Calm' (No. 44 of the *Liber*) is usually considered much finer in the third 'state' than in the first. The Techener reissue of Jacquemart's 'Gemmes et Joyaux' is better than the first 'state,' says Wedmore. In the second 'state' of Whistler's 'Kitchen' a large amount of added dry-point work appears, especially on the walls leading to the window, increasing the richness and harmony to a remarkable extent. On the other hand, the luminous quality and reflected light in the first 'state' of Turner's 'Crypt of Kirkstall Abbey' have become dull and flat in the second. Some of Meryon's plates have distressing additions in the later 'states,' strange birds and beasts and human beings, sometimes of a troubled mind. Nor could any amount of working change the fumbling effect of the body in Whistler's 'Becquet' (the 'cello player'), in which the interest is absolutely concentrated on the well-wrought head. There may be various reasons for preferring an early 'state.' Experience, developed taste and acquired knowledge of the individual case will determine your choice.»

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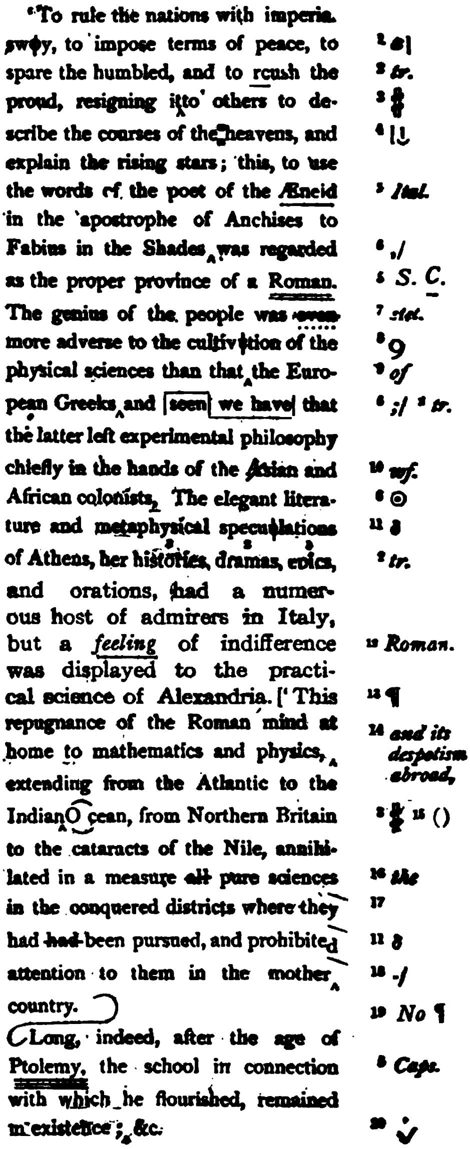
Esther Singleton.

PROOF, Ontological, or ONTOLOGICAL PROOF. See Ontology.

PROOF-READING, the process of reading the printed proof of matter to be printed, and marking errors, corrections, etc., on the margin. Proof-readers require to be expert in typography, as well as possessed of considerable education and general knowledge. An established set of signs is used. The specimen of a proof shown on this page exhibits most of these signs.

The immediate object of proof-reading or correcting is to mark every error and oversight of the compositor, with a view to make the printed sheet a perfect copy of the author's manuscript. This is done on the presumption that the manuscript is correct, which is seldom the case; and, therefore, the duty of a good reader extends to seeing that there are no inconsistencies in orthography, punctuation, abbreviations, etc., and in many cases to the verification of quotations, dates and proper names. Where extensive alterations, omissions or additions are likely to be made by writer or editor, it is more convenient to take the proofs on long slips called galley proofs, before division into pages. The making of new paragraphs, or the suppression of those in type and needless addition or omission of words that involve resetting many lines, should be avoided as causing trouble and expense.



"To rule the nations with imperia.
swφy, to impose terms of peace, to — 1 e|
spare the humbled, and to rcush the — 2 tr.
proud, resigning itto others to de- — 3 #
scribe the courses of the heavens, and — 4 |⊥
explain the rising stars; this, to use
the words ϲf. the poet of the Æneid — 5 Ital.
in the apostrophe of Anchises to
Fabius in the Shades was regarded — 6 ,/
as the proper province of a Roman. — 6 S. C.
The genius of the people was ~~even~~ — 7 stet.
more adverse to the cultivφtion of the — 8 9
physical sciences than that the Euro- — 9 of
pean Greeks and seen we have that — 6 ;/ 2 tr.
the latter left experimental philosophy
chiefly in the hands of the Asian and — 10 wf.
African colonists, The elegant litera- — 6 ⊙
ture and metaphysical speculations — 11 ∂
of Athens, her histories, dramas, epics, — 2 tr.
and orations, had a numer-
ous host of admirers in Italy,
but a *feeling* of indifference — 12 Roman.
was displayed to the practi-
cal science of Alexandria. [' This — 13 ¶
repugnance of the Roman mind at — 14 *and its despotism abroad,*
home to mathematics and physics,
extending from the Atlantic to the
Indian O cean, from Northern Britain — 3 # 15 ()
to the cataracts of the Nile, annihi-
lated in a measure ~~all~~ pure sciences — 16 the
in the conquered districts where they — 17
had ~~had~~ been pursued, and prohibited — 11 ∂
attention to them in the mother — 18 -/
country.
Long, indeed, after the age of — 19 No ¶
Ptolemy, the school in connection — 5 Caps.
with which he flourished, remained
in existence; &c. — 20 ✓

(1) A wrong letter. After every mark of correction a line / should be drawn, to prevent its being confounded with any other in the same line. (2) A word or letter to be transposed. Where letters only are to be transposed, it is better to strike them out, and write them in their proper sequence in the margin, like a correction. (3) A space to be inserted. This mark is also used when the spacing is insufficient. (4) A space or quadrat sticking up. (5) Alteration of type. One line is drawn under the word for *italics*, two for SMALL CAPITALS, three for CAPITALS. (6) Correction or insertion of points. (7) A word struck out, and afterward approved of (Latin *stet*, "let it stand"). (8) A turned letter. (9) An omission. (10) A letter of a wrong font. (11) A word or letter to be deleted. (12) Alteration of type. (13) A new paragraph. (14) Insertion of a clause. (15) A space to be removed or diminished. (16) A wrong word. (17) Straighten into line (18) Insert a hyphen. (19) No paragraph. (20) The manner in which the apostrophe, inverted commas, the star, and other references, and superior letters and figures are indicated.

The duty of securing consistency in spelling and punctuation is especially important in the case of works on which several writers are employed, such as newspapers and periodicals. The proof-reader has also to observe the numbering of the pages; arrangement of chapters, paragraphs and notes, running titles, etc. It is part of his business to observe the mechanical defects of the work — defective types, turned letters, inequalities of spacing between words, sentences and lines, crooked lines, and to secure symmetry in verses, tables, mathematical operations and such like. In almost all cases two proofs are taken, and in difficult works, such as those in foreign languages, tables, etc., even more. Lastly follows the revision, in which little more is done than seeing that the compositor has made all the corrections marked on the last proof. It is usual for the writer or author to reserve the correction of the second proof for himself. The work of a proof reader is more difficult than the uninitiated would believe. It requires extensive and varied knowledge, accurate acquaintance with the art of typography and, above all, a peculiar sharpness of eye, which, without losing the sense and connection of the whole takes in at the same time each separate word and letter. The proofreader usually is assisted by a second person, called the copy-holder, who reads aloud from the original copy, spelling out names, words in foreign languages and other words offering special difficulties. Proof-reading now is usually done by persons devoting themselves exclusively to this work. In earlier times it was the custom of publishers to employ scholars and writers and authors were in the habit of sending the proofs of their works to friends for the purpose of reading them. In the case of scientific books this custom is still frequently followed. (See Printing). Consult Appleton, D., and Company, 'Of the Making of a Book' (New York 1904); Booth, W. S., 'Notes for the Guidance of Authors' (New York 1900); Crapelet, G. A., 'Études Pratiques et Littéraires sur la Typographie' (Paris 1837); De Vinne, T. L., 'Correct Composition' (New York 1901); Henry, F. S., 'Printing' (New York 1917); Manly, J. M., and Powell, J. A., 'A Manual for Writers' (Chicago 1913); Smith, A. M., 'Exercises in Proofreading' (Philadelphia 1904); id., 'Proofreading and Punctuation' (Philadelphia 1905); University of Chicago, 'Manual of Style' (Chicago 1911); Vizetelly, F. H., 'Preparation of Manuscripts for the Printer' (New York 1905).

PROPAGANDA, a shortened name for the *congregatio de propaganda fide* (congregation for propagating the faith), founded by Gregory XV in 1622. It consists of a number of cardinals with the cardinal prefect at their head, has a general secretary and a vast number of inferior agents or employees. A special section is devoted to the Oriental rites. It is the central missonary association of the whole Roman Catholic Church, and superintends and guides missionary operations in all parts of the world. Under its direct control are now all countries in Europe and America where the ecclesiastical hierarchy is not established. Connected with it is the *collegium seu seminarium de propaganda fide*, usually called the Collegium Urbanum after its founder, Urban VIII, who instituted it in 1627 for the education of missionaries, students of all nationalities subject to the Propaganda being here received and trained and maintained free of expense, from the age of 14 years. Converts to the Roman Catholic Church who have come to Rome are instructed and supported by its funds. Bishops and other clergy who have been missionaries are also welcomed and supported there. The Roman Propaganda had, until within recent years, a printing-press, celebrated for the works which issued from it. The efforts of the propaganda are directed particularly to countries outside of Europe. In close connection with it stand a number of seminaries or colleges for missionaries in various countries, including the United States. (See Missions). Consult Benigni, U., 'Propaganda' ('Catholic Encyclopedia,' Vol. XII, New York 1911); Freri, J., 'Missionary Work of the Church' (New York 1908); Martinis, R. de, 'Ius Pontificum de Propaganda Fide' (7 vols., Rome 1889-98); Mejer, O., 'Die Propaganda, ihre Provinzen und ihr Recht' (2 vols., Göttingen 1852-53); Pieper, A., 'Gründung und Erste Einrichtung der Propaganda Kongregation' (Munich 1901).

PROPAGATION OF THE GOSPEL, Societies for. See Missions, Protestant, Foreign.

PROPELLER. See Screw-Propeller.

PROPERTIUS, prō-pėr'shĭ-ŭs, **Sextus**, Latin poet; b. Assisium, Umbria, about 50 B.C.; d. Rome, between 15 and 2 B.C. He is ranked by many as the greatest elegiac poet of Rome. Comparatively little is known regarding his life. He was deprived of his estate in the course of the agragrian confiscation and reduced to comparative indigence. Nevertheless he acquired a good education and was urged to take up the profession of advocate, but seems to have preferred devoting his energies to light literature and affairs of the heart, in which his love for the woman in his poems called "Cynthia" (her real name was Hostia), finally gained the ascendant and is reflected in much of his best writing. Propertius numbered among his friends Virgil and Ovid and engaged the patronage of Mæcenas. With Horace his relations do not appear to have been friendly. He was of a delicate constitution, pale and thin in person and of an emotional temperament in which melancholy seems to have had a large share, particularly in his late years. It is said of him that he was very careful about his personal appearance, almost foppish in his attention to dress and gait. The poems of Propertius consist of a collection of elegies usually divided into four books, though some commentators claim that they ought to be divided into five. All existant manuscripts, however, contain many gaps and have been in some instances more or less disfigured by corruptions. They are in their outward form modeled somewhat after the manner of the Alexandrine poets Callimachus and Philetas. He excels in the presentation of quiet description and emotion, "a fine and almost voluptuous feeling for beauty of every kind, and pleading and almost melancholy tenderness." English translations have appeared by Palmer, Paley and Postgate. The best texts are those by Hertzberg (1843-45); Keil (1850); and Haupt (1885). There are now no manuscripts in existence of his works that date earlier than the 12th century. The best and most complete manuscript is the so-called *Codex Neapolitanus*, now at Wolfenbüttel (12th century). Others are *Codex Vossianus* at Leyden (14th century); *Codex Laurentianus* at Florence (15th century); *Codex Daventriensis* at Deventer (early 15th century); *Codex Holkhamicus* at Holkham (1421); *Codex Urbinas* in the Vatican (15th century). The first edition was published in Venice (1472). Other editions of importance are by Passerat (Paris 1608); Lachmann (Leipzig 1816; Berlin 1829); Hertzberg (Halle 1843-45); Paley (London 1872); Bährens (Leipzig 1880); Palmer (Dublin 1880); Postgate (London 1894); Rothstein (Berlin 1898); Haupt-Vahlen (Leipzig 1904); Butler (London 1905); Phillimore (London 1911); Hosins (London 1912). English translations have been made by Kelly (London 1854); Moore (Oxford 1870); Cranstown (London 1875); Phillimore (Oxford 1906), and

Butler (London 1912). There are also translations into German, French, Italian and other modern languages. Consult Davis, J., 'Catullus, Tibullus and Propertius' (Philadelphia 1876); Gruppe, O. F., 'Die Römische Elegie' (2 vols., Leipzig 1838); Havet, L., 'Notes Critiques sur Properce' (in *École Pratique des Hautes Études. Paris Bibliothèque.* Paris 1916); Housman, A. E., 'The Manuscript of Propertius' (in *Journal of Philology,* Vol. XXI, p. 101; Vol. XXII, p. 84, London 1893–94); Jacob, F., 'Properz' (Lübeck 1847); Phillimore, J. S., 'Index Verborum Propertianus' (Oxford 1906); Plessio, F., 'Études Critiques Sur Properce et ses Elégies' (Paris 1884); Ribbeck, O., 'Geschichte der Römischen Dichtung' (Vol. II, Stuttgart 1900); Schanz, M., 'Geschichte der Römischen Literatur' (in 'Handbuch der Klassischen Altertumswissenschaft,' Vol. VIII, part II, No. 1, Munich 1899); Sellar, W. Y., 'Horace and the Elegiac Poets' (Oxford 1892); Solbisky, R., 'De Codicibus Propertianis' (Weimar 1882); Teuffel, W. S., 'History of Roman Literature' (Vol. I, London 1892); Ullman, B. L., 'The Manuscript of Propertius' (in *Classical Philology,* Vol. VI, p. 292, Chicago 1911).

PROPERTY, Laws of. Anything, whether tangible or intangible, which can be reduced to possession or made the subject of ownership, comes within the legal definition of property. The sea, the waters of rivers and the atmosphere enveloping the earth are for the common use of all men and can become the exclusive possession of no individual; wherefore they are not designable as property. But a thing may be property and subject to ownership without being the physical possession of the owner. With respect to intangible objects physical possession is impossible. One may own land without being in occupation thereof either personally or by representation; but a copyright is not a thing that one can put in a wallet and carry around on his walks. Here are two objects of ownership, one intangible and the other the most concrete of earthly things, in the case of which the fact of proprietorship may be, and in the latter instance must necessarily be, merely a matter of record. Some things are loosely spoken of as property which are not really objects of ownership in a legal sense. A man has a right to his good name, but he does not "own," though colloquially speaking he may be "robbed" of it. The capability of being transferred is the quintessence of property. One cannot transfer his personal reputation to another, but good will, patent rights and many other intangibles are property because they may be bartered and sold like goods and chattels. But ownership implies not only the transferability of the thing owned, but also the possibility of transferring the same. If a man were alone in the world he could call nothing "mine," says Kant. The relation of ownership is not a relation between the man and the thing but between him and other men, whom he excludes from, and to whom he gives, possession. Property is an "exclusive" right and where there are no people to exclude, the right cannot exist.

Primitive Law.— In early society one should not expect precise conceptions of proprietory and other legal rights to be prevalent. Nothing is further from the truth than the theory of the "Law of Nature" that the institution of property is the result of a social contract, whereby each individual surrendered a part of his liberty — meaning the privilege of doing whatsoever he pleased — in consideration of being secured in the remainder of his rights, including the possession of his belongings. In the "state of nature" the legal conception of ownership is absent and possession is merely a fact, not a right. Primitive man took unto himself everything within his ability to take and kept all he was capable of defending. Mankind was ruled by the might of the strong. Even in a relatively advanced stage of civilization the possessor was expected to protect his own by force. When an early Englishman had slain another while resisting dispossession by an intruder, the question to be determined in any ensuing lawsuit would not be whether violence in the defense of possession was justified, but whether the defender should pay a penalty, and if so, how much, for killing the trespasser. Under nearly all early laws larceny is punishable with death and the injured person is permitted to inflict the penalty on a manifest thief. These rules of self-protection are very different from legal prescriptions or constitutional guaranties — and there is in the latter not a trace of their derivation from a primordial social contract. On the contrary, the primitive conceptions of property conform in a crude way with those of 19th century utilitarianism. Everything that an individual could acquire and successfully defend (in the savage state by brute strength, in the condition of individualistic materialism by power of law) was regarded as absolutely his own and disposable at his volition.

Between these two poles of extreme individualism there lie social ideals of many degrees, varying longitudinally in point of time and latitudinally according to the stage of civilization attained by those who hold them. The periods of historic time and social progression do not synchronize, so that the greatest diversity of property laws may coexist in different parts of the world. The salient sociological fact, however, is that the institution of property (when it has been raised above the cave man's level of anarchic self-sufficiency) has everywhere passed through a communistic stage. When this step in advance has been made a man may individually own his weapons and implements, a woman her distaff, spinning wheel and personal ornaments; everything else, however, is usually owned in common — the land by the *gens,* clan or commune; the chattels by the family, the paterfamilias functioning as trustee, so to speak. But collective ownership is not found to be incompatible with individual possession. Quite the opposite, in the social stage referred to the division of the common property for singular use and enjoyment is a subject of supreme concern. A partition of the arable land is made between the families of the commune or tribe, annually or less frequently, for the purpose of cultivation; woodlands and pastures are preserved as commons, while the ground occupied by the family domicile is usually granted for possession in perpetuity, with a reservation of ultimate ownership by the community. Collectivism in this primitive form has persisted to the present day in the Russian “mir.” When the system breaks down communal ownership is not superseded at once by individual ownership, but by the quasi-corporate ownership of property by the family group. The homestead and farmed land became the inalienable and indivisible family *allod* of early Teutonic law and, while chattels were let and hired and could be pledged and forfeited, the alienation of patrimonial property was an affair of families, not of individuals, which was accomplished by a clumsy adaptation of the Roman *hereditas universalis*. Clear traces of the precedent communal system of proprietorship are found in the laws of republican Rome. The paterfamilias with all his despotic powers could not divest his descendants of their heritage and, when there were no descendants, property reverted to the *gens*, whose right of succession could be defeated only by a will made with the consent, and in the presence, of the entire *comitia*, armed and drawn up in battle formation. In the village communities of India the primitive Aryan collectivism has developed to a most complicated system of ownership, not only with respect to houses and land, but to all property. Everything a member of the community acquires, from an elephant down to a soldering iron, theoretically becomes a part of the common stock, though there are minute regulations securing to individuals the possession and use, and the disposition or bequest of the same. The conception of absolute individual ownership is of modern origin, relatively speaking, among European nations, but it seems to have prevailed in the ancient monarchies of Chaldea, Assyria and Babylonia. The Mosaic law ordered the redistribution of property by tribes and families in the jubilee years.

Roman Law.— Early Roman law made a distinction between *res mancipiæ* and other things. With the former were classed *immobilia*, corresponding in a general way with what he calls real property, though the term was more comprehensive, extending not only over lands tenements and hereditaments, furniture, fixtures and everything that could be considered as part of an estate, including some slaves (glebemen) and other chattels. *Res mancipiæ* were considered a more dignified kind of property than mere merchandise, and could be transferred only by *mancipium*, a ceremonial form of contract, at the execution of which many witnesses representative of interests in the subject-matter of the bargain were required to be present. The absence of one of these, the mispronunciation of a ceremonial word or the omission of a gesture made the contract a nullity. Ceremonial impediments and the trammels of collectivism are incompatible with the rapid exchange of commodities. Rome is now generally believed to have been in its origin an Etruscan trading post, established in the midst of an agricultural Latin community. The power of the merchant or tradesman to dispose of his merchandise in his sole right has to be recognized if commerce is to be successfully conducted. Possession must be assumed to give, and a transfer without formalities suffice to pass, title. The rules applicable to articles of commerce brought to port by Greek and Punic traders, or manufactured in Rome, by plebian artificers, were presently applied also to the products of patrician Roman farmers, and, ultimately, to *res mancipiæ* without distinction. Possession, or dominium, was defined by the Roman lawyers with great precision, the *jus possessionis* being quite the most important part of the Roman law of property; nor are their reasonings mere speculative niceties. Possession, as the saying still goes, is nine points of the law, and, as Bentham remarks, “in defense of his possessions a man may lawfully strike, wound or kill, if need be.” To constitute possession or dominium two elements are required, the ability to take and the will to hold. The desire to have a bird in the bush does not give possession to one who is unable to catch it; the power to seize a stray cow does not make one a possessor who has not the least intention of exercising his power. These corporeal and mental constituents of the act of possession are designated *corpus* and *animus domini*.

One may have possession of a thing, *dominium*, without being in actual contact. A soldier is in possession of his rifle lying within reach; the purchaser of goods in storage is in possession when he holds the key to the warehouse where they are stored; an heir is in possession of the entire estate, though he may have entered only on a part of it or merely viewed it from a distance. The essence of possession is the power to exclude others. A man is in possession of things left at his domicile, though they have not been touched by him nor by anyone in his behalf; but not of a treasure buried on his grounds unless he may have dug for it and actually found it. The distinction is reasonable, though rather fine. One is in more complete control of one's house and its contents than of one's fields and what is hidden therein, and one may be forestalled by another in lifting a treasure. It should be remembered that these definitions have reference to *dominium* as a juristic fact and not to the rightfulness of the possession. The will to control, *animus domini*, is manifested in perfection by those only who rightly or wrongly recognize no superior or parallel right in any other person to possess the thing held. The intention of a servant, who resists the taking of property entrusted to him by his master, is merely to protect it from violence, without any assertion of right over the same on his own behalf. So also, where the intention to hold or dispose of an object is limited by the distinct recognition of the outstanding rights of another — as in the case of a tenancy or bailment — the Roman law regards the holder as lacking the *animus domini*, i.e., the intention to act as owner to the complete exclusion of everybody else. The difference between the Roman and Teutonic and English laws in this respect is not so great in fact as it seems, however. The interdicts provided “real” remedies for the protection of possessory rights, analogous to actions of replevin or suits in ejectment, of which only “exclusive” possessors could avail themselves; bailees and lessees having no rights *in rem* had to take recourse to personal actions to redress their injuries. Even to this rule the Roman law made important exceptions. A non-contractual tenant, *tenens precario*, a ground-renter for a long term of unimproved agricultural land, *emphyteusis*, the holder of a pledge, and a *sequester* (receiver or trustee) could resist dispossession by actions *in rem.* Loss of the power to exclude or of the will to control, of course, makes an end of possession or *dominium.* A temporary interruption of use or occupancy, however, is not a relinquishment of the possessory right. One who regularly pastures his cattle on a certain meadow during the summer does not abandon his use because he does not graze there in the winter also; nor may one who leaves his possessions in charge of a steward and goes abroad be presumed to surrender his power of control. Neither does failure to exercise the will to possess and to exclude others terminate a *dominium,* when the failure is due to a legal disability — the possessor being a minor or a lunatic, for instance.

Ownership, *proprietas,* is a further development and amplification of the right of possession. Indeed *dominium* or exclusive possession implied ownership. But one may own a thing, though one have no actual control over the same — while property may be denuded of every attribute that gave it value and ownership therein still persist. In this condition the Roman law designates it *nuda proprietas.* The right of ownership includes the right to possess, and an owner out of possession obtains restitution in virtue of the *jus vindicandi.* Ownership has been defined as «complete dominion over a thing.» The owner of property has the right of disposal; he may sell it or give it away, and he may destroy it. But the owner's rights are limited by other rights. No man may use his own in a manner injurious to others, and all property is held subject to the right of the State to tax or take for public purposes, or to restrict the uses to which it may be put by the owner. The «complete» dominion of the owner, moreover, is diminished by servitudes and co-ownership, and the right to possess is suspended by letting or hiring, deposits, pledge, mortgage, etc. Ownership is extinguished by conveyance, gift or bequest, by long-continued adverse possession and by the death of the owner. Ownership may be derivative or original. It is derivative when acquired by purchase, gift or inheritance. Original ownership is established by *occupatio, accessio, specificatio,* or *usucapio. Occupatio* (literally, laying hold of) applies to ownerless things, *res nullius,* in which class the Roman law places wild animals, treasure buried by one in a stranger's land and derelicts — the latter including all the property, whether public or private, of enemies, which was conceived to have no legal owner and to be subject therefore to capture. *Accessio* signifies an addition to property through no action of the owner as by the planting of a tree or the building of a house on one's land by another person. *Accessio* includes *alluvio,* the gradual deposit of soil by the sea or a running stream, and *avulsio* the sudden accretion of soil torn from another's property by a freshet or landslide. *Specificatio* refers to property that comes into being when one works material belonging to another into something new and different (*nova species*). A sculptor owns the statue he has carved, irrespective of the ownership of the marble. Even more obviously, a work of literature is the property of the author, not of the owner of the paper on which the manuscript is written. One who works up material for hire, or whose work is not creative in the same sense as an artist's, does not become a proprietor by *specificatio.* A tailor does not own the coat made from cloth furnished by his customer. Neither does the *speciefactor* become the owner when the material he has worked up can be restored to its original condition. Good faith, of course, is a pre-condition to the establishment of ownership by specification. *Usucapio,* the taking of a thing to one's own and exclusive use, is indistinguishable from what is known to English law as adverse possession, except that the periods of prescription in Roman law are shorter — one year for movables and two years for immovables. According to Roman law the right to possess can exist in such completeness as to constitute a *dominium* in only one person at a time. Partial or conditional possession of a thing does not make it property of the possessor in the juristic sense of the word. Ordinary leases create merely a contractual relation, not a proprietory right; and things lost by, or stolen from, a bailee are recoverable in a procceeding *in rem* only by the owner. Property in land includes not only the surface but the mineral wealth contained therein to any depth beneath.

Mediæval and Modern Law.— Teutonic custom distinguished less sharply than Roman law between ownership and inferior possessory rights. Delivery regularly passed title to movables. In some instances a bailee had the right of action, for a recovery of property to the exclusion of the owner. Possession was regarded as equivalent to ownership, except with respect to things lost or stolen, though a lender or pledgor had the reversion or equity of redemption, of course. The distinctions between rights in movable and immovable property, which had almost become obliterated in the Roman system, was reasserted and broadened in the *leges barbaroum.* Rights in land could only be acquired by inheritance or by «investiture,» and the transfer thereof was restricted, not only by the interests of the ruling classes, but by the rules of family community. The distinction became still more marked by the establishment all over Europe of the system of feudal tenures. This system gave paramount ownership, *dominium eminens* to the sovereign, in the first instance, and secondarily to the baronial and manorial lords — and made the possession and use of land dependent upon the performance of military and other public, or quasi-public duties or, in the case of peasant leases, upon the rendering of customary services to the lord. Tenures (even peasant holdings in Germany) became hereditary, but the right of alienation was late in obtaining recognition. The eminent domain of the sovereign or lord gradually lost the character of a property right and became a governmental power, while the use and possession, *dominium utile,* slowly developed into ownership. The hereditary peasant leases have been converted into full proprietorship by modern legislation. The reservation of forests to, and the control of hunting and fishing by, the feudal lords were the foundations for the exercise of similar powers by the modern State. Wild animals, when objects of sport, could be hunted and taken only by those authorized or licensed to do so and the sovereign prince claimed as his own many things regarded by the Roman law as *res nullius* and subject to private capture and appropriation — for example, abandoned land, treasure trove, wrecks, flotsam and enemy property. The right to minerals under ground was separated from the ownership of the superficies, and mining privileges could be exercised only under license from the overlord, which was usually given to the first finder in consideration of a share of the profits. Nearly all these rights and the royalties — literally the king's fees — derived from them have passed into modern law as rights and revenues of the State. In modern European legislation the distinction of movables from immovables is nominally preserved, but has long since been obscured by the practical uniformity of the rules governing the right to hold, dispose of or inherit property, irrespective of its mobility or immobility. All property to which there is no one entitled to legal possession belongs, or escheats, to the State. The Code Napoleon awards *trésor* (treasure trove) to the finder and so does the Civil Code of Germany. The Roman rules of «accession» and «specification» have been generally accepted, though stress is laid in some modern codes upon the relative value of the nova species produced and the material out of which it has been fashioned. Such modern law terms as *domaine, Eigenthum* and *property* define rights identical with those defined by *dominium* and *proprietas*, their Roman equivalents, except that modern law regards some forms of qualified possession as proprietory in character. The most advanced view of modern European jurists is that which regards possession as not a right, but a «social function,» the recognition and protection whereof by the State is conditioned upon the exercise of the privilege (or function) of ownership to the greatest possible advantage of the community as a whole. The Swiss Code declares the misuse of property to be unlawful.

English and American Law is characterized by the cleavage between the rules governing «real» and «personal» property. This cleavage is due in the first instance to the exceptional character impressed upon estates in land by the feudal system — land being «held» not owned. The terms «real» and «personal» however, did not originally define two kinds of property, but indicated a distinction between various early forms of judicial procedure. A «real» action was one whereby possession of the thing itself, which was the subject matter of the controversy, could be recovered. In a personal action the suitor laid claim to, and could obtain no more than, an indemnity (damages) for the withholding of, or injury done to, a thing or his rights therein. The indestructibility of land, and the powers and dignity attached to the tenure thereof, favored recourse to «real» actions to recover possession by those dispossessed, or prevented by trespassers from the use and enjoyment, of such property. By the most obvious association of ideas the subject matter of «real» actions became «real» property. The distinction between real and personal property does not coincide, however, with the distinction between movables and immovables, or between an estate in land and the ownership of goods and chattels. Not all interests in land could become the subjects of «real» actions. Leaseholding was deemed degrading to a «freeman,» the payment of rent in manual labor, in money or in kind, being considered an act of servility. The right of a tenant was not vindicable by a «real» action and, when dispossessed, even though the dispossessor be his landlord, the tenant's only recourse was a «personal» action for damages. The measure of damage being rent paid, if he paid nothing after dispossession, he could recover nothing. Easements, rents and profits, however, are real property, because they were rights to which the early common law extended the protection of «real» remedies. The right of property in chattels is absolute in the highest degree, a man may do as he will with his own. A man's right to his land, however, is not so untrammeled. No man has the right to excavate his own land so as to withdraw lateral support from his neighbor's land and the buildings thereon; no man may vitiate the air over his neighbor's land by noxious gases or malodorous vapors, or impair the value and usefulness of other property by maintaining nuisances on his own; no man may divert or otherwise unreasonably interfere with watercourses running through his own and other land. Further limitations are placed on proprietory rights in land by building codes, and by zoning commissions and other public authorities. Intangible objects, such as patents, good will, etc., are property just the same as are tangible objects. Ownership is a right *in rem*, meaning a right which the owner holds against the whole world, as distinguished from a right *in personam*, which is actionable only against one or more ascertained or ascertainable persons. When a right *in rem* is infringed a right *in personam* comes into existence, which is enforcible against the infringer. This right, however, is not correctly defined as possessory. English and American legal terminology, whereby *choses in action* are called «property» is, therefore, rather confusing. In all essentials the American and English law of personal property is in harmony with the modern European and ancient Roman laws. Feudal tenures were never recognized in the United States and have been formally abolished in England by statute. The distinction between real and personal property survives mainly in the differences in the rights of succession and inheritance, and in the formal methods required for transferring title to land, while ownership of goods is conferred by their mere delivery. Peculiar to American law are the Constitutional guarantees, which forbid the taking of private property for public uses without compensation of the owner, or the deprival of any man of his possessions except as punishment for crime and by due process of law.

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PROPERTY PROTECTION. See INTERNATIONAL UNIONS FOR THE PROTECTION OF PROPERTY. a. *Industrial*; b. *Private*.

PROPERTY TAX. See TAXATION.

PROPERTY TEST FOR SUFFRAGE. See ELECTORAL QUALIFICATIONS.

PROPHET. See PROPHECY.

PROPHET, an insect, the praying mantis. See MANTIS.

PROPITIATION, the act or means of appeasing or atoning. It is a Biblical and theological term applying especially to Christ and his death. Saint John (1, ii, 2) says, «He (that is, Christ) is the propitiation for our sins.» The end of all the sacrifices prescribed in the Old Testament was to obtain propitiation, to propitiate an offended Creator. See ATONEMENT.

PROPOLIS. See BEE-KEEPING.

PROPHECY. I. Definition.— The word prophet is derived from the Greek word προφήτης, which doubtless meant originally an interpreter, then more specifically an interpreter of deity. Hence a prophet may be defined as a person who is considered to speak by the direct inspiration of a deity or spirit, while prophecy is the message of a prophet. The prevailing idea that the fundamental meaning of prophecy is prediction is thus erroneous, although prediction is often associated with the work of a prophet. Prophecy was thus an endeavor to ascertain the will of the deity by personal or subjective means, in contrast with omens and some forms of oracles which used external means.

II. Prophecy among other Nations aside from the Hebrews.— Prophecy was common in the early history of the world, although ordinarily much less frequently than oracles and omens. It prevailed particularly in Greece. Specially celebrated was the Pythia, the priestess of the Pythian Apollo at Delphi, who spoke in an ecstatic state supposed to be caused by vapors from a chasm in the temple. There were also various sibyls in Greece, their number varying in the traditional accounts from four to ten. These sibyls were highly esteemed by the Romans and some of their written productions were regarded with great veneration. In the Semitic group of peoples, aside from the Hebrews, there is no explicit evidence of the presence of prophets among the Babylonians and Assyrians, nor among the Canaanites, although their existence among the latter people is often inferred from their similarity to the Phœnicians. They are found among the Arabs, being there called by the name kahin, which is the same as the Hebrew word for priest, and the Arab prophets sometimes acted also as priests. They are also found in the service of the Phœnician Baal, as appears from the Old Testament accounts. No important written records of the utterances of any of these prophets outside of the Hebrew people have been preserved, the Sibylline Books, reputed to be of Greek authorship, being almost entirely late Jewish compositions, thus really pseudonymous, with some Christian fragments. Prophecy among other nations aside from the Hebrews was ordinarily of the clairvoyant type, being given in answer to specific questions of individuals, and hence of no general or permanent value.

III. Hebrew Prophecy. 1. *General Conception.*— The usual Hebrew word for prophet is נָבִיא. While the meaning of the word is disputed, it seems probable that its etymological significance is «speaker»; hence it has the fundamental idea of one who speaks for God, in accordance with the discussion above. The Hebrew prophet always spoke in the name of Yahweh. As among other nations, there are indications that in early times prophets and priests were connected; even some of the later prophets, as Jeremiah and Ezekiel were from priestly families.

2. *Historical Development.*— Considered historically, the Hebrew prophets may conveniently be divided into three classes, which are not, however, entirely distinct from each other, an individual sometimes exercising functions belonging to more than one class, and all of them having certain characteristics in common. These classes may be called seers, oral prophets, and writing prophets. The seer was consulted by individuals concerning personal matters, Samuel, according to one representation, belonging to this class, 1 Sam. ix, 7–8. This class seems to have been an early development, but it probably continued active until a late period. The oral prophets were concerned with the affairs of the nation and of the king as the representative of the nation. Their work, however, was specific, their usual task being to give advice concerning a particular situation, especially when consulted by the king. These may be called largely, but not entirely, professional. Many no doubt also acted as seers. The writing prophets were distinguished superficially by the fact that, while their messages were ordinarily proclaimed orally, later these messages were committed to writing, either by the prophet himself or by his disciples. But this really resulted from a deeper distinction. Their messages were actually characterized by great and permanent significance; they not only gave advice in reference to a particular situation, as Isaiah to Ahaz and Hezekiah, but they based this on fundamental and comprehensive teaching concerning God, his relations to men and his principles of action. The presentation of new truth is thus specially characteristic of the writing prophets, and some of the greatest messages of the Old Testament come from

them. These prophets were clearly not professional. What are usually called the prophetic books of the Old Testament contain the messages of this class, as well as other portions, such as the prophetic narratives of the Pentateuch known as J and E.

3. *Characteristics of the Prophets.*— The prophets often formed guilds, living together in communities. These guilds are frequently called «sons of the prophets,» compare also the designation «a band of prophets,» 1 Sam. x, 5, 10. Such guilds are mentioned several times during the life of Samuel, 1 Sam. x, 5, 10; xix, 18–19, etc., in the time of Elijah and Elisha, 1 Kings xx, 35; 2 Kings ii, 3, 5, 7, 15, etc., and in the time of Amos, Amos vii, 14. Presumably this was a continuing feature. Samuel and Elisha were particularly connected with these guilds. The writing prophets were independent of them and sometimes hostile.

Gifts or fees to the prophets were customary. A fee for professional services was expected when a seer was consulted, 1 Sam. ix, 7–8; 1 Kings xiv, 3. A gift of first-fruits was made to Elisha, 2 Kings iv, 42. The prophets seem ordinarily to have made their living by prophesying, as is indicated by Micah iii, 5; Ezekiel xiii, 19; Amos vii, 12, etc. But no such gifts seem to have been made to the writing prophets, and Amos repudiates the idea, Amos vii, 14.

The prophets were often marked by a distinctive dress, viz., a hairy mantle, 1 Kings xix, 13; 2 Kings i, 8; Zechariah xiii, 4. Naturally this would be especially characteristic of the prophetic guilds, the writing prophets apparently not following the practice. A distinctive sacred mark in the forehead is mentioned only once, 1 Kings xx, 41.

In the early times religious estacy or frenzy was a prominent characteristic of the prophets, 1 Sam. x, 9–13; xix, 18–24, as was the case also with prophets of the Phœnician Baal, 1 Kings xviii, 28; similar is the condition of Elijah when he runs before the chariot of Ahab, 1 Kings xviii, 46. In 2 Kings ix, 11 one of the prophets is called mad. This frenzied condition was excited especially by music, consult 1 Sam. x, 5; 2 Kings iii, 15. This condition is not mentioned in the later time and doubtless gradually ceased. Dreams and visions were also part of the experience of the prophets. But these, especially dreams, became less frequent in the later times.

The prophets, especially the oral prophets, often gave a message that suited those consulting them, in particular messages of prosperity for the king and the nation. Such prophets may be described as professional, they regarded their work as a profession with no high conception of its religious significance. Some of these prophets were no doubt insincere, other perhaps merely professional and conventional, repeating the messages of earlier prophets with no distinctive addition of their own. In the Old Testament these are not described as false prophets, but, at times, as prophesying falsely or prophesying lies. The writing prophets come into sharp opposition with prophets of this kind. The favorable message of such prophets is mentioned in Isaiah xxx, 10; Micah iii, 5; 1 Kings xxii, 13; Jeremiah xxiii, 17; xxviii, 1–4, etc. Several of the oral prophets, however, exerted a very important influence in reference to national affairs. Thus Samuel anointed Saul as king, and later announced his rejection and anointed David; David followed the instructions of Gad, 1 Sam. xxii, 5; Nathan gave David directions concerning the temple, 2 Sam. vii, 1ff, and rebuked him for his sin, 2 Sam. xii, 7; while the importance of the work of Elijah and Elisha is well known.

The conviction of the prophets that Yahweh was speaking through them seemed universal. This appeared to be quite as strong in the case of the lower professional prophets as with those of a higher kind. How fully this conviction was justified in each case, therefore, must be determined by careful study, especially by the contents of the individual message.

The dominant purpose of the actually sincere prophets may be stated thus: so to present the truth of God as to produce practical religious results. This appears from a study of the various elements in their messages, and of course applies more fully to those of the higher kind. The national interest has a fundamental religious basis; the social teachings, prominent as they are, are essentially religious; and the ethical teachings, which are conspicuous, have a religious centre. The teaching is pre-eminently practical rather than speculative, the message of the prophet was fundamentally a message to his own time.

In connection with what has already been said, the matter of prediction and fulfilment may be noted. The message in prediction, as elsewhere, was for the time of the prophet; the aim of prediction, therefore, was not to present a program for the future, but to teach the comprehensive truth concerning God and His principles of action for the sake of the present effect. Hence the prediction was not a statement of that which the prophet thought must necessarily take place, but rather a presentation of the prophet's expectation or ideal, with a view to the encouragement or warning of his hearers. Fulfilment of details, therefore, is not to be expected and does not ordinarily appear; there is a more general fulfilment in the realization of the principles that are stated.

In the latter part of the Old Testament, chronologically considered, prophesy began to pass into apocalyptic, as in the book of Daniel and in small portions of other books, which finally replaced prophecy in the Jewish thought of the two centuries before Christ and the first century after Christ. See APOCALYPTIC LITERATURE.

IV. *Prophecy in the New Testament.* In the New Testament the prophet is in general an interpreter of God's message, who speaks to the edification of the church, 1 Cor. xiv, 3, 24, 25, prediction being only rarely mentioned, as in Acts xi, 28; xxi, 10—11. Prophets formed a special class in the church, ranking next after apostles, 1 Cor. xii, 28; Eph. iv, 11, and much superior to the possessors of the gift of tongues, 1 Cor. xiv, 5, 39.

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PROPONTIS. See Marmora, Sea of.

PROPORTION, an equality of ratios; a series in which the first of any even number of terms bears the same mathematical relation to the second term as each other odd-numbered term does to the even-numbered term which immediately follows; thus 4, 12; 5, 15; 6, 18 (or 4:12=5:15=6:18, or 4:12::5:15::6:18, these forms being read «4 is to 12 as 5 is to 15 as 6 is to 18,» etc.) is a *geometrical* proportion. The definition given above using the words «same mathematical relation» shows that there may be other than geometrical proportions, in which the relation is the fundamental one of multiplication (or division). The fundamental relation of addition (or subtraction) also gives rise to a proportion, the so-called *arithmetical* proportion; thus 4, 6; 7, 9; 11, 14, or, generalizing, a, $a+d$; b, $b+d$; c, $c+d$, are in arithmetical proportion as each odd-numbered term is related to its corresponding even-numbered term by the difference 3. The distinction between geometrical and arithmetical is here the same as in progressions (q.v.), and the proportion is merely a special case of progression. It is perfectly obvious that the concept of the proportion may be applied elsewhere, the relation for example being not that of multiplication (or division) nor that of subtraction (or addition), but that of evolution (or involution); htus 4, 16; 5, 25; 11, 121, is a series in which the analogy between terms 1 and 2, holds in the case of terms 3 and 4, as well as terms 5 and 6, the relation being that of the root to the square. But this general concept of the proportion or analogous relation finds small place in mathematics, even the most modern theory being little fresher than Euclid's Fifth Book, which was derived in part from Pythagoras, and which is, save for the difficulty in the treatment of incommensurables, far superior, though reckoned more difficult, than the numerical treatment which came into vogue in the Middle Ages; Euclid's method is concerned with lines, instead of numbers. To all intents and purposes the modern method like Euclid's is concerned merely with geometrical proportions. In a geometrical proportion the odd-numbered terms are called the antecedents, the even the consequents; the first and fourth terms the extremes, the second and third, the means. A mean proportion has the second and third terms identical as $a: b=b: c$, which may more conveniently be written $\frac{a}{b}=\frac{b}{c}$. The chief properties of a geometrical proportion, say $\frac{a}{b}=\frac{c}{d}$, are the following: (1) the product of the means equals the product of the extremes, $bc=ad$ (clear of fractions); (2) the terms are in proportion by composition, $\frac{a+b}{b}=\frac{c+d}{d}$ (add 1 to each member of the original equation); (3) the terms are in proportion by division, $\frac{a-b}{b}=\frac{c-d}{d}$ (subtract 1 from each member); (4) the terms are in proportion by composition and division, $\frac{a+b}{a-b}=\frac{c+d}{c-d}$ (divide the equation in (2) by the equation in (3)).

PROPORTIONAL REPRESENTATION, as its name suggests, is the result obtained when the members of legislative bodies are so chosen that each party or faction in the voting population is represented by a number of delegates proportionate to its numerical voting strength.

Proportional representation gained respectability as a reform in England and the United States largely as the result of the able exposition of its principles made by Mr. Thomas Hare in 1859 and John Stuart Mill in 1862. Since its underlying principle, as will be later pointed out, is destructive of the two-party system which forms the framework of the present English and American political structures, it is natural that it should have received scant recognition or approval from party leaders. It has been put into practice in the United States only in those rare instances in which the principle of non-partisanship has found expression, — instances thus far confined in the main to cities in which the new forms of commission or city manager organization have been adopted. The socialist party indorses its application in State and National governments, and one or two non-political organizations are conducting campaigns of education in its behalf.

Method of Operation.— The nature and working of proportional representation may best be made clear by an examination of the two leading methods which have been devised to give it effect.

(a) *The single transferable vote.*— This system is applicable to an election in which several representatives are to be chosen from a large constituency. Suppose six vacancies are to be filled by an electorate of 60,000 voters. Under the usual bi-party system each party would nominate six candidates and the party which cast the majority, or even the plurality in case more than two parties had tickets in the field, would elect all six representatives. It might be, therefore, that 31,000 voters would elect all the representatives and the other 29,000 would go unrepresented. By the use of the single transferable vote each voter would vote not for six candidates but for one. Any candidate, therefore, who received 10,000, or one-sixth of the total vote cast, would be elected. In this way any group in the community which had this much voting strength could secure the election of one representative. With no other provisions for expressing a preference between candidates this system would, of course, tend to give the same representation to all groups of voters alike provided they could each cast a vote of 10,000. A voter might, therefore, find himself wasting his vote by casting it either for a man who had already received more than enough votes to elect him or for a man who did not receive enough to elect him. To avoid this difficulty the single vote is made transferable by allowing the voter to indicate his second, third, fourth, fifth and sixth choices or as many of them as he cares to indicate. If the man for whom he has expressed his first choice does not need his vote, or cannot be elected even with the aid of it, then his second choice vote is added to the total first-choice votes of the man for whom it is expressed, and so on. In this way, by counting as many of the later choices as are necessary to secure the election of six men each group in the electorate is able to elect approximately its proportionate share of the whole number of representatives. In other words, 40,000 of the 60,000 could by expressing their first four choices elect four men.

This system was roughly the one advocated by Hare and bears his name. It has been modified in many ways especially in the matter of the counting of the votes and the procedure in the elimination of the weak candidates. A good many detailed problems arise in connection with its application which cannot be mentioned here.

(b) *The List System.*— This system gives the voter a chance to express a preference not only for an individual candidate but also for a party or group. The names of candidates are put on the ballot in lists or blocks so that those of similar views are grouped together. The voter, as in the first system described, has but one vote to cast and he casts it for one candidate on one of the lists. This vote counts one in determining how many candidates the adherents of that list are to elect and it also counts one toward the election of a single candidate on that list. The proportion of the total vote which is cast for a single list determines the number of representatives which are chosen from that list; and when that number has been determined the highest candidates on the list are chosen. Thus a man may vote for a man who is defeated yet at the same time further the election of another candidate from the same list or party.

Minority Representation.— The chief difference in principle between proportional representation and minority representation is that the latter system seeks to secure the representation only of the leading minority party or parties. It may be presented in terms of the Illinois system of minority representation adopted in 1870 for the election of the lower house of the State legislature. This is a system of cumulative voting. From each district three representatives are to be chosen and each voter is given three votes to cast. He may cast them in any way he chooses,— one for each of the three candidates, two for one and one for another, one and one-half each for two, or all three for one candidate. The result is that any party in any district which can cast one-third of the total vote may, by concentrating or "plumping" all their votes on one man, elect him. In practice it has commonly worked out that the majority party has elected two candidates and the minority has elected one. The smaller minority parties go unrepresented. Under extraordinary circumstances the minority party by supporting solidly two candidates has been able to elect them both against the majority party which has unwisely scattered its vote among three candidates. To avoid this the party managers have usually tried to limit the number of candidates of their parties to the number they can reasonably expect to elect. In this way the freedom of choice of the voter is somewhat abridged.

Arguments for Proportional Representation.— The arguments in favor of proportional representation may be summarized as follows: First, it would prevent the non-representation of any respectable minority in the body politic but allow each group to enjoy that share in political power to which its numbers entitle it. The domination of majorities would be abolished. Second, attention would be centered upon the selection of men who represent a definite body of opinion rather than upon men who, as now, represent a definite geographical unit or district. Third, by the wide range of choice open in the election the necessity for complicated nominating machinery with all the evils attendant upon it would be obviated. Finally, it would tend to break up the bi-party system and the elaborate organizations and methods of control which that system produces, and replace it by a natural, informal and genuine alignment of the people along the lines marked out by the actual divisions in the public opinion of the community. This is peculiarly desirable in municipal government where the influence of State and National parties dominates municipal politics to the exclusion of local issues. For this reason proportional representation has developed most rapidly and successfully in cities.

Arguments Against.— The following arguments are advanced by the opponents of proportional representation: First, the system makes the formulation and development of a legislative policy very difficult. The legislature is composed of a large number of groups with no cohesive influence uniting them and the policies they work out are usually compromises which really do not represent the real views of any group. Furthermore, responsibility is lost in such a case. Under the two-party system each party goes before the people on a certain platform and the successful one may properly be held responsible for the carrying out of that policy. With a large number of parties the policy which is ultimately agreed upon is one upon which the electorate may never have expressed itself and no one group can be held accountable for it. Second, it is very hard to say just what is being represented in an election held under this system. The groups which may temporarily gather in support of a candidate may be based upon racial, religious, social, or political grounds, and the legislative body which results may be a mosaic of widely divergent and incompatible interests with no common ground upon which to meet. Third, it is urged that the average voter would not be able to vote intelligently the somewhat complicated ballot necessary to a proportional representation scheme; that it enormously increases the difficulties of counting the election and materially augments its cost.

Extension in the United States.—Although proportional representation in its various forms has been used rather widely in Europe for many years it has but recently made its appearance in this country. The first instance of its use was in the city of Ashtabula, Ohio, in 1915 where under a new city charter it was used in the selection of the municipal commission. In 1917 it was incorporated into the charter of Boulder, Colorado. It is being seriously considered as a desirable adjunct to the commission and city manager types of municipal government.

Consult Humphreys, 'Proportional Representation' (1911); Commons, 'Proportional Representation' (2d ed., 1907); Hoag, 'Effective Voting' (1914; Sen. Doc. 359, 63d Cong. 2d Sess.); Holcombe, 'State Government in the United States' (1916); *Proportional Representation Review* (published quarterly); *Equity* (published quarterly); Library of Congress, a List of Books and References to Proportional Representation (1904).

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PROPOSITION, (1) *in mathematics,* a statement in terms of something proposed to be proved or done. (2) *In grammar,* a sentence, or part of one, consisting of a subject, a predicate, and copula. (3) *In logic,* a sentence, or part of a sentence, affirming or denying a connection between the terms; limited to express assertions rather than extended to questions and commands. Logical propositions are divided: First, as to substance, into categorical and hypothetical; secondly, according to quality, into affirmative and negative; and thirdly, according to quantity, into universal and particular. (4) *In poetry,* the first part of a poem, in which the author states the subject or matter of it. (5) *In rhetoric,* that which is proposed, offered, or affirmed, as the subject of a discourse or discussion.

PROPRÆTOR. See Proconsul.

PROPRIETARIES, in American history, a common name applied in colonial days to those indivduals to whom colonies had been granted by the Crown. Most of the 13 English colonies were originally proprietary but New York, New Jersey and the Carolinas became royal provinces and only Pennsylvania, Delaware and Maryland remained such until the time of the Revolution. In proprietary governments, the proprietor appointed the governor, and in general enjoyed all those prerogatives of government which in monarchies were attached to the Crown. The laws of Pennsylvania and Delaware were subject to the supervision and control of the Crown; those of Maryland were not. Consult Edgerton, H. E., 'A Short History of British Colonial Policy' (London 1897); Id., 'The Origin and Growth of the English Colonies and Their System of Government' (Oxford 1903); Doyle, J. A., 'The English in America' (5 vols., London 1882–1907); Hart, A. B., ed., 'The American Nation: A History' (Vol. V, New York 1904); McCrady, E., 'The History of South Carolina under the Proprietary Government' (New York 1897); Mereness, N. D., 'Maryland as a Proprietary Colony' (New York 1901); Osgood, H. L., 'The Proprietary Province as a Form of Colonial Government' (in *American Historical Review,* Vol. II, p. 644; Vol. III, pp. 31 and 244, New York 1897–98); Shepherd, W. R., 'History of Proprietary Government in Pennsylvania' (in *Columbia University, Studies in History, Economics and Public Law,* Vol. VI, New York 1896); Whitehead, W. A., 'East Jersey under the Proprietors' (Newark 1875); Winsor, J., ed., 'Narrative and Critical History of America' (Vols. III and V, Boston 1884–87).

PROPRIETARY GOVERNMENT. See Colonial Government, Proprietary.

PROPYL (C_3H_7), the third radical of the series $C_n H_2\,{}_n1$. It does not exist in the free state, but enters into the composition of a large series of important compounds.

PROPYLÆA, prŏp-ĭ-lē'ạ, *in Greek architecture,* the entrance to a temple. The term was employed particularly in speaking of the superb vestibules or porticoes conducting to the Acropolis (q.v.) or citadel of Athens, which formed one of the principal ornaments of the city. This magnificent work, of the Doric order, was constructed by Pericles (437–433 B.C.) after the designs of Mnesicles, one of the most celebrated architects of his age. Pausanias says it was covered with white Peutelic marble, remarkable for the size of the blocks and the beauty of the workmanship. It was built on the foundation of an earlier gateway and was never fully completed. The imposing structure consisted of three parts: a central gateway with wings on the north and south. The building has suffered much from the ravages of foreign invaders, but even its ruins show clearly the wonderful beauty which must have been possessed by the original structure. Consult Boetticher, A., 'Die Akropolis von Athen' (Berlin 1888); Bohn, R., 'Die Propylæen der Akropolis zu Athen' (Berlin 1882); Doerpfeld, W., 'Die Propyläen der Akropolis von Athen' (in *Kais, Deutsches Archäologisches Institut, Athenische Abteilung, Mitteilungen,* Vol. X, pp. 38 and 131, Athen, 1885); id., 'Zu den Bauwerken Athens' (in ib. Vol. XXXVI, p. 51, Athen 1911); Elderkin, G. W., 'Problems in Periclean Buildings' (in *Princeton Monographs in Art and Architecture,* No. II, Princeton 1912); Frazer, J. G., 'Pausania's Description of Greece' (Vol. II, London 1898); Harrison, J. E., 'Primitive Athens as Described by Thucydides' (Cambridge 1906); Judeich, W., 'Topographic von Athen' (in 'Handbuch der Klassischen Altertums-Wissenschaft, Vol. III, pt. I, No. 2, Munich 1905); Middleton, J. H., 'Plans and Drawings of Athenian Buildings' (in *Society for the Promotion of Hellenic Studies, Supplementary Paper,* No. 3, London 1900); Dinsmoor, W. B., 'The Gables of the Propylæa at Athens' (in *American Journal of Archæology,* Vol. XIV, p. 143, Norwood 1910); Penrose, F. C., 'Principles of Athenian Architecture' (London 1888); Rohden, H. von, 'Proyläen' (in Baumeister, A., ed., 'Denkmäler der Klassischen Altertums,' Vol. III, p. 1414, Munich 1888); Stuart, J., and Revett, N., 'Antiquities of Athens' (Vol. II, London 1784); Weller, C. H., 'The Pre-Periclean Propylon of the Acropolis at Athens' (in *American Journal of Archæology,* Vol. VIII, p. 35, Norwood 1904); id., 'Athens and its Monuments' (New York 1913).

PROROGATION OF PARLIAMENT, in Great Britain, the continuance of Parliament from one session to another, as adjournment is a continuance of the session from one day to another or for a longer period. Prorogation determines the session, but adjournment does not. After a prorogation any bill which has previously passed both houses or either house, without receiving the royal sanction or the concurrence of the other house, must be taken up *de novo*. Parliament is prorogated by the king in person or by his commissioners. The death of the crown or the calling out of the militia or reserves during a period of prorogation, immediately put an end to the latter. See Great Britain — Parliament.

PROSAURIA, a subclass and also an order Palæozoic reptiles. See Herpetology.

PROSCENIUM, prō-sē'nĭ-ŭm, in Greek and Roman theatres, the place where the actors appeared. It was in front of the rear wall or *skene*. The front part of it, where the actors stood, was called in Greek *logeion* or *ocribas* and in Latin *pulpitum* and was elevated above the rest of the stage. The orchestra was in front of it. The place where the actors dressed and undressed, was called *postscenium*. Projecting wings on each side of the proscenium were called *parascenia*. In the modern theatre it designates that part of the stage located between the curtain and the orchestra and usually including the proscenium arch. The boxes, immediately adjoining the stage, therefore, are usually called proscenium boxes.

PROSCRIPTION, *in Roman history*, a mode of getting rid of enemies, first resorted to by Sulla in 82 B.C. and imitated afterward in the years that closed the republic. It literally signifies "a writing before" and commonly meant an advertisement or announcement of articles to be sold. But Sulla applied it to a proclamation containing names of citizens and promising a reward to any person who should kill those named in the lists and a threat of death to those who should aid or shield them. The persons named were said to be proscribed. Their property was confiscated and their children were declared incapacitated for public office. The most notorious proscription after that of Sulla was that posted by the second triumvirate — Antony, Octavianus Cæsar and Lepidus (43 B.C.), in which was included the name of Cicero.

PROSE LITERATURE. See Literary Forms.

PROSECUTOR, *in law*, is one who prosecutes another for a crime in the name of the government, whether public or private. A public prosecutor is an officer appointed by the government to prosecute all offenses. In the United States the chief law officers that are public prosecutors are the attorney-generals of each State and there are subordinate officers known as State, district or county attorneys. Federal offenses are prosecuted by the attorney-general of the United States and the United States district attorneys. A private prosecutor is one who prefers accusations against a person whom he suspects to be guilty and if he acts from proper motives he will not be responsible to the party in damages, although he was mistaken in his suspicions, but if from a motive of revenge he caused a criminal prosecution without reasonable foundation, he would be liable in an action for malicious prosecution. A prosecuting attorney bringing an action in the name of the people is presumed to have authority. His powers are limited to the preparation and trial of cases.

PROSELYTE (Greek, an arrival or newcomer), he who leaves one religion for another. In New Testament times there were proselytes of two degrees, the proselytes of the gate who renounced idolatry and worshipped the only true God according to the (so-called) seven laws of the children of Noah, without subjecting themselves to circumcision and the other commands of the Mosaic law, and were only admitted to the court of the temple, and stood at the door of the inner temple, whence their name; having the right of dwelling in the land of Israel, but only in suburbs and villages; and the proselytes of righteousness who had been fully converted from paganism to Judaism, had been circumcised, and bound themselves to observe the Mosaic law. Before their circumcision they were examined respecting the grounds of their conversion; after their circumcision they received baptism, being immersed with their whole body in a cistern full of water, on a festival, in the presence of three judges. This baptism, known under the name of proselyte baptism, was repeated in the case of those children of a proselyte who had a heathen mother. Boys under 12 and girls under 13 could not become proselytes without the consent of their parents, or, in case of their refusal, the aid of the magistrates. By the baptism every one was considered as born anew, so that his parents were no longer regarded as such, and slaves thus baptized were set free. Consult Bertholet, A., 'Die Stelluing der Israeliten und der Juden zu den Fremden' (Freiburg 1896); Brandt, W., 'Die Jüdischen Baptismen' (Giessen 1910); Graetz, H. H., 'History of the Jews' (6 vols., Philadelphia 1891–98); Schürer, E., 'Geschichte des Jüdischen Volkes' (4 vols., Leipzig 1901–11).

PROSERPINA, prō-sėr'pĭ-nạ. See Persephone.

PROSODY (Greek, *prosōdia*), the part of grammar that treats of quantity, accent, metre and the laws of versification. See Rhyme; Rhythm; Verse.

PROSPECT PARK, N. J., borough in Passaic County, on the Passaic River, forming a residential suburb of the city of Paterson, which it adjoins. Pop. 2,719.

PROSPER (Fr. prǫs-pâr) **OF AQUITAINE,** also called **PROSPER TIRO,** Christian poet and religious controversialist: b. Aquitaine, about 400; d. soon after 463, probably at Rome. He was a layman, probably a teacher of rhetoric and had settled in some city of Provence (perhaps Marseilles) when Saint Augustine's work on 'Correction and Grace' reached Southern Gaul. In that country there were many Semi-Pelagians who taught that Saint Augustine's doctrine of grace militated against the notion of Free Will. Prosper with a companion went to Rome after the death of Saint Augustine in 431 and induced Pope Celestine to write a letter against the Gallican Semi-Pelagians. Prosper also wrote a Latin dogmatic poem of over 1,000 hexameters, 'On the Ungrateful,' as he styled the Semi-Pelagians who seemed ungrateful for the gift of divine grace; many essays on 'Grace and Free Will' and a most valuable chronicle, *Epitoma Chronicom*, which brings the history of the French church down to 455; and he compiled a *Liber Sententiarum* from Saint Augustine's works. There are many editions of his works. The best collection of them is to be found in Migne, J. P., ed., 'Patrologiæ Cursus

Completus' (Vol. LI, Paris 1846). The best recent edition of his chronicle is included in Momrusen, T., ed., 'Monument Germaniæ Historica Chronica Minora' (Vol. IX, Berlin 1892). Consult Potthast, A., 'Bibliotheca Historica' (2 vols., Berlin 1896); Valentine, L., 'Saint Prosper d'Aquitaine' (Toulouse 1900); Wörter, F., 'Prosper von Aquitanien über Grade und Freiheit' (Frieburg 1867).

PROSPERO, one of the principal characters in Shakespeare's romantic drama, 'The Tempest' (q.v.). He is the rightful duke of Milan, but is dispossessed of his dukedom by his brother Antonio and the king of Naples, and with his daughter Miranda is put adrift at sea in a leaky boat. Having reached a desolate island he establishes a refuge for himself and daughter, with Caliban, a half-human monster, the only inhabitant he found on the island, as servant. He takes up the practice of magic which he had studied at Milan, raises a tempest which wrecks upon his island coast Antonio, the king of Naples and their suites, and saves them from drowning only to subject them to various punishments until he finally reveals himself, and gives them his forgiveness. All prepare to return home, Miranda meantime betrothed to the King's son Ferdinand. Prospero then breaks his wand and renounces magic. Consult Carpenter, W. B., 'Shakespeare's Tempest' (in 'Religious Spirit in the Poets,' p. 103, New York 1901); Furness, H. H., ed., 'A New Variorum Edition of Shakespeare' (Vol. IX, Philadelphia 1892); Moulton, R. G., 'Shakespere's Tempest' (in *New Shakespere Society, Transactions*, 1887, Ser. I, p. 37, London 1887); Rolfe, W. T., ed., 'The Tempest' (New York 1904); Stephens, G., '"The Tempest": An Outline Sketch of the Play by William Shakespeare' (Stockholm 1836).

PROSSER, Charles Allen, American educator: b. New Albany, Ind., 20 Sept. 1871. He was educated at the universities of De Pauw, Louisville and Columbia. He was superintendent of schools for the Children's Aid Society in 1909–10 and deputy commissioner of education for Massachusetts in 1910–12. In 1912 he became secretary of the National Society for the Promotion of Industrial Education; and he was director of the Minneapolis Survey in 1915, in which year he became director of the William Hood Dunwoddy Institute at Minneapolis. Author of 'New Harmony Movement' (1903); 'The Organization and Administration of Vocational Education' (1913); etc. He was general editor of the 'Vocational Education Series' of the American Book Company in 1913.

PROSSNITZ, prŏs'nĭts (Czech *prostějov*), Austria, a town of Moravia, 11 miles southwest of the town of Olmütz, on the Rumza. There are two railway lines. It is the centre of a fertile and prosperous region. It has extensive manufactures of woolen and linen cloth, cashmere and cotton goods, in all of which it carries on an important trade; numerous distilleries of brandy and rosolio, extensive breeding of geese and one of the largest corn-markets in Moravia. The city hall is an interesting ancient building. There are German and Czechish schools. Most of its inhabitants are Roman Catholic Czechs, but there is a large Hebrew congregation. Pop. 31,462.

PROSTATE GLAND, the pale, firm body composed of both muscle and gland, in shape resembling a chestnut, which surrounds the neck of the bladder and the beginning of the urethra in the male. It consists of two lateral lobes and one middle lobe. The excretory ducts from the glandular substance of the organ open into the prostatic portion of the urethra. It is well supplied with blood-vessels and nerves and is enclosed in a thin but firm fibrous capsule. The secretion of the prostate is a milky, viscous fluid of acid reaction, discharged under sexual excitement with the semen and forming for the latter a fluid vehicle. Enlargement of one or more lobes of the prostate is very common in men over 55. The cause is not known. It is said that such enlargement has never been found in eunuchs, or where the testicles have been lost. The enlargement encroaches on the rectum and urethra, interfering with their functions, the bladder becoming distended; its walls may be thin and inefficient and a cystitis may be set up. In this disorder the stream of urine becomes slower; there is a frequent desire to urinate, even at night, but only a few ounces of urine are passed each time. Exhaustion, sepsis from retained urine and sometimes local hemorrhage cause enlarged prostate to be a serious condition. Treatment includes mild and easily digested food, regulation of the bowels, freedom from exposure to cold and damp and the careful use of the catheter. Sometimes enucleation of the enlarged gland (prostatectomy) is of value; so are Bottini's operation, burning a channel through the obstructing mass, and vasectomy, the cutting of the vas deferens. Removal of the testicle to reduce the size of the prostate is sometimes resorted to. Acute prostatitis, an acute inflammation, is most often due to gonorrhœa or to strong injections for its relief, but may arise from the irritation of calculi or the use of instruments, etc. The symptoms are painful and frequent micturition, swelling, high fever, retention of urine and tenderness in the region of the lower bowel and the neck of the bladder. The inflammation may progress so far that suppuration (prostatic abscess) occurs. The treatment requires rest in bed, hot anodyne fomentations, leeches, purgation and opening of the abscess. Chronic prostatitis may be the sequel of the acute form, or it may be primary. There is less swelling, pain and tenderness than in the acute. It is a condition which needs the supervision of the physician or surgeon. Tubercular disease of the prostate may either be primary or be secondary to similar disease of the testes. There are nodular lumps, which may break down and produce an abscess. The disease may invade the bladder and the whole urinary tract. The prostate is subject, though rarely, to malignant tumors, carcinoma and sarcoma. Prostatic calculi about the size of millet-seed are quite common in old men. They rarely give rise to noticeable symptoms unless inflammation occurs. Sometimes they are voided or they may form the nucleus of a prostatic calculus.

PROSTITUTION. See HYGIENE, SOCIAL.

PROSTYLE, *in architecture*, a portico in which the columns stand in advance of the building to which they belong. The term *amphi-prostyle* is used when there is such a portico attached to a building both in front and behind.

PROTAGORAS, prō-tăg'ō-raṣ, Greek sophist: b. Abdera, Thrace, about 480; d. about 410 B.C. He studied the old Ionian philosophy paying especial attention to Heraclitus, and he was the first to assume the title of Sophist, and to teach for pay, a practice which, Plato informs us, proved very remunerative. He taught principally at Athens. When, about 443, a number of Athenians left the city to join in founding the new colony of Thurii, Protagoras was appointed by Pericles to accompany them and subsequently drew up a constitution for the Thurians. Before returning to Athens he lived for some time in Sicily, where he acquired great fame. He returned to Athens before 430. In 411 he was brought before the Aeropagus for beginning one of his works ('Concerning the Gods') with the words, "Respecting the gods, I am unable to know whether they exist or do not exist," was banished for atheism, and perished at sea. He was the author of a large number of works, all of which are lost. The two most important of them were the ones already mentioned, and another entitled 'Truth.' One of the dialogues of Plato (q.v.) bears the title 'Protagoras,' and yields some information regarding his mode of teaching. His famous apophthegm, *ἀνθρωποςμέτρον* (man is the measure of all things) has become the eternal possession of philosophy and can never lose its significance. Man from his subjective impressions can, he said, decide what things are, and what things are not. Hence he taught that Science was impossible and Opinion everything. This was what in modern philosophy corresponds to Sensualism. For these views he was controverted by Socrates and the Socratic school. He is also credited with being the first grammarian to have systemized grammar and to have been the originator of a classification of the parts of speech, tenses and moods.

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PROTANDRY. See POLLINATION.

PROTECTION is a term in political economy, employed to describe the policy of indirectly promoting the growth of national industries, either to secure the defensibility of the country in time of war, or to promote its general welfare, or both. It differs from Socialism in seeking this by indirect means, and with the minimum of interference with individual freedom, recognizing that the true function of government is to steer the ship of state in industrial matters, and not to propel it. It differs on the other side, from free trade, which excludes government from any kind of activity in the industrial sphere, and especially objects to any legislation which will have the effect of diverting capital and labor into channels in which they would not otherwise flow.

More than one way to this end has been used, such as the absolute prohibition of specified imports, premiums upon exports, bounties upon home production, and the retention of raw material. But the usual way has been to impose, upon the competing product from abroad, a duty sufficient to discourage its use and to make it unprofitable to the dealer. Such duties are either *ad valorem* or specific. The former are levied upon the value of the imported commodity, and are either directly or inversely proportional to that value. Thus the duties imposed by the British Corn Laws rose as the price of wheat fell, and the converse. Specific duties are those which tax the commodity by number, weight or bulk, irrespective of differences in value. For protective purposes they are preferable.

From the rise of national feeling in Europe, at the close of the Middle Ages, to the Congress of Vienna in 1815, all governments pursued the policy of protection to home industry. Among economic theorists a protest against this was begun by the French *Economistes* (Gournay, 1754; Quesnay, 1758; Turgot, 1766). It found its finest exposition and defense in their Scotch disciple, Adam Smith (1776), who contended that the interplay of self-interest is quite sufficient to secure the best industrial development, and that when every man is left to "do as he will with his own," he will do what is best for society. The antipathy of Napoleon I to this theory, and the questionable means he employed to counteract it in his Continental System, seemed likely to give it a chance of being applied in the states represented at the Congress of Vienna. But a few years of actual experience satisfied the rulers and cabinets of the Continent that the path to national prosperity did not lie in that direction. They returned to protection, which England and France, indeed, never had abandoned, and which Germany made effective for the whole country through the Zollverein (1817–33).

It was in the United Kingdom, in 1846, after eight years of popular agitation by the Anti-Corn-Law League, that a European government first took steps to abandon Protection, and that after 510 years of it had lifted England out of the dire poverty of a merely agricultural country, into the first rank among manufacturing nations. And even she continued to protect her silk and glove industries against French competition, until the Cobden Treaty of 1860 agreed to the abolition of these duties.

Twenty years later there began a reaction against free trade, which is now supported by the Conservative party. It grew out of the failure of that policy to obtain the support of other countries, and the rapid growth of France, Germany and America in commerce and manufactures under protection, while England became more dependent upon the rest of the world for food, and was obliged to keep up a great navy that her ports might be kept open in case of war with any one or several European powers. The outbreak of war in 1914 emphasized this necessity. The destruction of many merchant vessels by German submarines, and the diversion of others to transport use, reduced her means of bringing food from abroad, so that importations are limited by royal order to things thought necessary. Even strenuous free traders now recede from the principle adopted in 1846, and propose that home production shall be fostered and importations restricted by imposing duties on these. In this they revert to the principle laid down by Nassau W. Senior in 1835, that the economist has no right to dictate the policy of the statesman, since economic reasonings are only a part of the considerations which should influence him.

In America the need of a national government, which could extend protection to the prostrate industries of the States, was one of the most powerful motives to the formation and adoption of the Constitution of 1787, which authorized Congress to impose duties on imports «to pay the debts and provide for the common defence and general welfare of the United States.» The harsh experiences of the war for independence had shown the country the need of manufactures for the defense of the nation. It was on this ground that Washington repeatedly pressed for adequate legislation; and in this he was supported by his secretary of the treasury, Alexander Hamilton.

The great President, in his address to Congress in 1790, said, «A free people ought not only to be armed but disciplined, to which end a uniform and well digested plan is requisite; and their safety and interest require that they should promote such manufactures as tend to render them independent of others for essentials.»

Duties were steadily adapted to this end, until the political revolution of 1801 brought Jefferson into office. From that time no advance in the direction of more adequate protection were made, although only the duty on salt was repealed, with the result that the country had a second salt-famine during the war of 1812-15. Its sufferings in this, and other industrial wants, effectually converted Jefferson from free trade but is was not until 1824 that the country returned to an effective protective policy.

The South, however, found that its adhesion to slavery precluded it from entering upon manufactures, and now began to antagonize protection as an encroachment on the rights of the States, although her cotton-growing industry had been brought into existence and advanced to prosperity by a protective duty continued for many years. Her threats of nullification led to the adoption of the tariff of 1833, which provided for the gradual reduction of all duties to a 20 per cent level by 1840. The general suspension of manufacturing through this reduction and the derangement of the currency brought about the severe depression of 1837–42, and caused another political revolution in the election of a Protectionist Whig to the presidency in 1840.

During the four years of the tariff of 1842 there was a great and general restoration of prosperity; but the influence of the example set by England, and the prospect of open markets in that country for western and southern products, brought about another change. The tariff of 1846 embodied no economic principle, but effected a large reduction of duties below the protective level. In 1857 these duties were farther reduced by one-fourth, and another severe depression of industry helped to the election of Mr. Lincoln in 1860. Before he came into office the Morill tariff had been passed by Congress and signed by President Buchanan.

This was done in view of the certainty that a civil war at home was impending, and that it might involve the country in hostilities with England and France. It was therefore felt necessary to put the country in the way of equipping itself for any emergency. The relation of home industry to national defense thus indicated, was amply shown in the distresses and disabilities of the Southern Confederacy, which solemnly committed itself to free trade in its Constitution, and was dependent upon its friends in Europe for military and other supplies. For over 30 years our country persisted in this policy of protection, with some unhappy experiments in the reduction of duties,— notably those on wool and woolens in 1883. The presence of a surplus of revenue in the national treasury was made the pretense for demanding «Tariff reform,» meaning an advance toward free trade. In spite of partial victories, nothing was effected until after Mr. Cleveland's second election in 1892. The tariff of 1893 fell far short of what he and his friends wished, but it went as far beyond what the country would endure, and brought about a reaction and a return to Protection.

This continued until a division of the Republican party on other grounds, in 1912 brought back the Democrats to power under a President devoted to free trade. The tariff of 1913 is a distinct step in that direction. It has not been so harmful as some earlier tariffs, because the vast development of wealth and industrial power under the long continuance of Protection has given the country some power of resistance to legislation adverse to our industrial interests. Also the depression which followed upon its adoption was neutralized in many fields of industry by the outbreak of war in Europe, as this created an immense demand for the products of our two greatest industries — agriculture and metal wares. European competition was checked also by the diversion of millions of men from industry to military service, and by the seclusion of Germany and Austria-Hungary from foreign commerce. At the same time we were shown the folly of depending upon foreign producers for our supply of indispensible articles, such as dye-stuffs. Some of these were placed under a moderate protective duty by the votes of the party which had enacted the tariff of 1913, and measures were adopted to prevent our markets being flooded with European goods at sacrifice prices after the close of the war, as was done in 1783 and 1816.

The Reasons for Protection are numerous and mutually supporting. (1) The necessity of varied industries for the national defense has been indicated already. It was again shown in the Boer War, in which a brave people were handicapped by their being a merely agricultural population, in conflict with a great manufacturing country. It was amply illustrated in all nations involved in the great World War. (2) The variety of industry, which Protection establishes, is not less necessary to defend the country from the perils of famine. A country which produces food only, is liable to famine and its consequent pestilences, whenever the rains are too scanty or too plentiful for the harvesting of the crops. Such a country has all its eggs in one basket, and should that fall, it has nothing to fall back upon. Ireland and India became famine countries through the destruction of their manufactures by English legislation and by English competition. They will remain such until they secure the independence which will enable them to enact the protection of their home industries they both desire. All the regions visited by famine in modern times — Persia, central Russia, northern China, northern Sweden, Asia Minor, and even some districts of our own country,— are merely agricultural communities. (3) Protection secures the general welfare of the producers of the country, by bringing each class into the neighborhood with the others, which supply its wants and demand its goods. It thus saves the cost of carrying products over land and sea to find a market and bring back, at a like cost of carriage, whatever is taken in exchange. The railroads of the country save about $5 a ton on having their worn rails converted into new, through not being obliged to send them to rolling-mills in Europe. The farmer gets more for his crop when he has the artisan close at hand to consume it, and obtains in greater abundance what the artisan produces, even if he has to pay a higher money-price for it. All this advantage is lost when a country keeps its farms on one continent and its workshops on another, and spends both strength and money in transportation which could be avoided. (4) The naturalization of varied industries by protection gives the people of the country greater liberty to choose the kind of work they prefer, and a finer opportunity to develop their natural capacities in improving old methods or inventing new ones. This has been especially true of America, whose people were taunted for their backwardness in invention before this became a manufacturing country. An English manufacturer declared we could not make so much as a mouse-trap for ourselves. American inventions have lightened the burden of toil for half mankind. They have made many staple articles, such as steel, cutlery, cotton and silks, cheaper to the whole world. The American character has been distinctly improved by emergence out of the stage, at which farming and shipping furnished almost the only employments, and has grown in manifoldness and energy. (5) The variety of industry, at which Protection aims, is highly useful in drawing the people of the country in closer relations, and thus contributing to the unity of will and understanding, which underlie national unity. It was by the trade between the English colonies that the fierce prejudices of our earliest time were overcome. It was through the development of foreign commerce at the expense of home trade that the Union was imperiled. As Mr. Carey showed Mr. Lincoln, our railroad lines ran only to the seashore, to facilitate exports and imports. They now run north and south as well. By the Zollverein and its fostering of home trade, Germany was helped to national unity. The English sneered at the notion that the Germans could «spin and weave themselves into national unity,» but the result came. (6) By preventing adverse balances of trade, Protection guards the national supply of solid money from being drained out of the country. Money is «not a commodity like any other,» as to whose incoming and outgoing we can afford to be indifferent. It is the means of organizing labor for the conquest of nature and the production of wealth. And it is not indefinitely replaceable, as are many other commodities. To exchange it for hardwares and textiles is to exchange power itself for the products of power. Laveleye compares such an exchange with that between two parties of hunters, who should trade game for guns and ammunition, while at a distance from the basis of supply. Nor is it true, as some economists tell us, that the loss of gold and silver have no other effect than to lower prices in the country which exports them, and thus lead to a return of coin by purchasers from aboard. Prices are lowest in the countries which have the most money, because labor is organized there to the best advantage, and is thus made more productive. «Start a shilling in Thibet, and it will turn up in London.» It goes to where it will buy more commodities, though less labor. Therefore is it true that the gold of the world tends constantly to the great centres of money and of manufacture, moving on the same lines with the commerce in food and raw materials. By refusing this unequal commerce, we have ceased to be a gold-exporting country, and have thus obtained that stock of money which enables us to organize labor on a great scale, and acquire industrial power.

The Objections to Protection are many in form, but they resolve themselves into a few. (1) It is charged that «protection is hostile to commerce. If we do not buy, we cannot sell. Thus we are deprived of the possibility of disposing of our surplus products.» But with the single exception of England since 1846–60, all the great commercial nations have practised protection; and under that policy our own exports have reached a figure not equaled by any other country in the world, our rate of progress in this respect being rivaled only by protectionist Germany. In truth, nations buy of each other just what they must, and sell all they can, and means of payment are always found. (2) It is objected that "the interest of the consumer is that of society at large, while the interest of the producer is that of a class only. Free trade promotes the former, while protection seeks the latter. For the consumer is interested simply in getting what he uses as cheap as possible, and with this a protection duty must interfere." But "better than a low price for any article is a fair price," Mr. Lowell says. The times of especial cheapness are what we call "hard times," and even the free trader fails to recognize his own ideal in those times. Like other people he begins to talk of an "improvement in prices," meaning a rise. In considering the effect of protective duties upon prices it is necessary to look at both sides of the account. Nearly every one in the community has something to sell, and it is of small use to him to be able to buy at a low rate, if he must sell at a still lower. Ireland is a land of cheapness, but not to the advantage of its people, who cannot find a market for their labor. Nova Scotia is another country of low prices, and its people flock in thousands to Massachusetts, to seek employment at such wages as they never can earn at home and to live in comfort there. The free trader fixes attention on one side of the account, to the neglect of the other. Nor is the consumer, in the long run, obliged to pay higher prices because of protection. Mr. Greeley used to challenge the free traders to mention a single article whose manufacture had been protected for 14 years, without falling in price below the point at which it has stood. All kinds of commodities in this country are cheaper to the consumer than they were before the enactment of the Morrill Tariff. The national consumption of all has increased far more rapidly than the increase of the population. (3) It is alleged that "Protection is but a method of forcing a hot-house growth of industries, which would have come to us naturally, when our density of population warranted the transition from farming to manufactures. The latter arise when there is a real need and demand for them, without any interference on the part of government." This statement is not supported by any historic instances of this natural growth. Every nation, which now possesses such industries, made its beginnings under Protection. Every great industry that is fighting for the markets of the world was built up by protective duties. On the other hand, everyone admits that the want of manufactures is the root of the misery of Ireland and of India. The governmental commission to investigate the cause of Indian famines reported, in 1885, that nothing but the diversion of a large part of the labor of the people to manufactures would put an end to them. The need of both countries is beyond question, for in both the density of population has passed the point at which people can live by the soil. But neither of them possesses the power of transforming mere need into effective *demand*, by native legislation. How long are they to wait for that "natural growth?" (4) Adam Smith's argument from the beneficial effects of what he called "natural liberty" supposes that "individual self-interest is enough to secure all the industrial growth that any country needs or should want. If everyone be left free to do as he will with his own, he will do what society needs to have done." Those who repeat this argument are never willing to apply it to other forms of the state's activity, which affect industry. They do not propose to have the merchants of each seaport keep its harbor in condition by their individual or even their united action. They dare not assert that individual self-interest has not inflicted deep and lasting injury of our country in the devastation of its forests, the destruction of its game, and especially the extirpation of insect-destroying birds. They sustain the government in making the coinage of money and the carrying of letters public monopolies, and punishing all who invade either. They have ceased to look to private self-interest for the maintenance of a school system adequate to our national need. They make all these exceptions to their own theory, and the protectionist adds one more. Adam Smith's principle, however, has great truth. It is the rule, and all these other things are the exception. The protectionist differs from the free trader in that he has no panacea or cure-all to offer to the public. He has only a specific for a single social defect, and he alleges in its favor that it interferes as little as possible with personal liberty. (5) It is objected that "protection favors the manufacturers at the expense of their laborers and of the farmers of the country." As for the laborers, protection does not set aside the law which Carey, Bastiat and Atkinson have shown to govern the distribution of profits. The laborer's share of the joint-product of capital and labor constantly increases, while that of the capitalist constantly diminishes. Protection makes that joint-product greater with every expansion of industry, and thus secures to the workman a higher standard of living and a greater opportunity to save. Between 1860 and 1880, the wages of labor, measured in the power to purchase the staple commodities, more than doubled in this country. While free labor in America was once little if anything above the slave's level, as to the enjoyment of the necessaries and comforts of life, it is now on the highest level that it ever has attained in history. The superior condition of American labor was shown by an investigation carried out by our own government in 1911, and still more strikingly by one conducted by the British Board of Trade through the English consuls in 1912. The London *Times* sums up the result, "The workman in America enjoys an enormous advantage over his fellow in England. . . . He earns two and a quarter times as much money, and works shorter hours for it, so that his hourly rate of earning is as 240 to 100. Against that enormous difference in wages there is something to be set in the way of expenditures, . . . but the cost of living is only as 152 to 100. The advantage in regard to the cost of food is less than it looks. A workman living on the American scale pays only 25 per cent more for his food than he would in England." The Board of Trade itself says, "The margin is clearly large, making possible the command of the necessaries and minor luxuries of life greater than that enjoyed by the corresponding class in this country." The farmer is directly cared for in the tariff, being secured by the great market for his produce which our manufacturing districts furnish him. From that market the protective tariff shuts out his Canadian competitor, in spite of the demand of our free traders, seconded by some short-sighted manufacturers, that we shall return to the reciprocity which existed from 1854 till 1867. The farmer is also benefited indirectly by having his market for produce brought into his neighborhood, thus making his exchanges more equal. As an English newspaper put this years ago, «when the western farmer in America had free trade, he gave a pound of butter for a pound of nails. But under protection he gets 14 pounds of nails for his pound of butter.» (6) It is alleged that «protection favors the formation of trusts, and thus destroys that domestic competition, which the protectionist himself relies upon to secure reasonable prices.» Yet a large number of our trusts, beginning with the Standard Oil Company, are almost independent of the tariff. Of the rest, very few have been able to secure such a control of production as to have the power to dictate prices; and of these several avoid attempting it. Their especial product is as cheap as before the trust was formed, their new gains coming from the saving of expenses. Others still are international trusts, of the sort that would be sure to abound if we abandoned protection. Nor are the countries which practise free trade characterized by unlimited competition among producers. Wherever the trades-union has obtained the control of the rate of wages and of the hours of labor, capitalists have been led to combine for mutual protection. They naturally think that they cannot afford to buy labor in a close market and sell their product in an open one. Unified control has come to be the rule in the great English industries, and they have improved upon our example by including the workingmen in their arrangements for adjusting prices and wages.

The general movement of American industry to better conditions under the protective policy is shown by some statistics of our national position at the beginning of our longest period of protection and the last national census, 1910.

	1860	1910
Population	31,443,321	91,972,266
Wealth	$14,183,000,000	$167,579,806,316
Share per capita	$454	$1,822
Exports	$333,576,057	$1,487,764,991
Imports	$353,616,119	$823,172,165
Wages	$378,878,966	$3,427,032,000
Wage earners	1,311,246	6,615,046
Average earnings	$289	$518
Savings banks deposits	$149,277,504	$4,070,486,247

Thus while population in that half-century increased 180 per cent, our wealth increased 1,815 per cent, and the individual share in it 301 per cent. The increase in our exports was 331 per cent, and that of our imports only 130 per cent, or less than the growth of population. While the number of wage earners increased 404 per cent, the wages paid increased nearly 800 per cent; and the savings banks deposits nearly 2,702 per cent.

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PROTECTION, New England Order of. See NEW ENGLAND ORDER OF PROTECTION.

PROTECTIVE ASSOCIATION, American. See AMERICAN PROTECTIVE ASSOCIATION, or «A.P.A.»

PROTECTIVE COLORATION. See COLORATION, PROTECTIVE.

PROTECTOR, in the history of England, a person appointed to act as regent generally during the minority of the king. Those on whom it was conferred were the Earl of Pembroke, in 1216, during the minority of Henry III; Humphrey, Duke of Gloucester (1422–47), during the minority of Henry VI; Richard, Duke of York, February 1454 to February 1455, and November 1455 to February 1456; Richard, Duke of Gloucester, in 1483, before the death of the young princes, his nephews, and his own accession to the throne; and the Duke of Somerset (January 1547 to October 1548), during the minority of Edward VI. On the 12th of December, 1653, the title of lord-protector was bestowed upon Cromwell (q.v.), as head of the Commonwealth of England, Scotland and Ireland, by the provisions of the Instrument of Government. At his death, in 1658, he was succeeded by his son, Richard Cromwell (q.v.), who, however, abdicated in 1659.

PROTECTORATE, a term applied to the relationship existing between a strong nation and a weaker one wherein the former undertakes to protect the latter from hostile invasion or other form of aggression and in consequence exercises more or less control over its domestic and entire control over its foreign affairs. The protectorate, unlike the colony, does not lose its individual sovereignty; its people do not become citizens of the protecting state; if the protecting state goes to war with another power the protected state may remain neutral. The relation has, however, often been a mere cloak for absolute dependency on the part of the weaker nation, which for reasons of state it has seemed expedient to disguise. The term protectorate is also applied to the state thus protected. The relation between a protectorate and its protector is usually established by treaty, although sometimes it is the result of mere understanding only. There are two classes of protectorates which differ essentially from the existing circumstances: (1) Where both nations are civilized; (2) where the protector is civilized and the protectorate is not. Most of the protectorates of the present day belong to the second class and are to be found in Asia and Africa and the islands of the Pacific Ocean. Notable examples of existing protectorates are Tunis, Annam, Tonking, Madagascar and Somali Coast under French protection; and North Borneo, Bechuanaland, Somaliland, British Central Africa, British East Africa protectorate, Uganda protectorate, the Sudan and Nyassaland under British protection. Italy also maintains a protectorate in Africa. The United States has from early times exercised similar control over weak nations in various parts of the world. One of these was Liberia on the west coast of Africa and founded by the American Colonization Society in 1820. It has been understood all along that no other nation would be permitted to annex it or interfere in its affairs. Likewise Hawaii for a short time occupied the position of a protectorate until its annexation to the United States in 1898. From 1882 to 1897 the United States was one of the three powers to exercise a protectorate over the Samoan Islands. Likewise from 1836 to 1845 it exercised a protectorate over the republic of Texas. From 1846 to 1903 the United States as a result of treaty with Colombia exercised a quasi-protection over the Isthmus of Panama for the purpose of ensuring the neutrality of the Panama Railroad. Partly as a result of American aid Panama seceded from Colombia in the latter year and virtually placed itself under the protection of the United States. The most perfect example of an American protectorate at the present time is that of the republic of Cuba, which secured its independence of Spain in 1898 chiefly through the intervention of the United States and which upon demand of the American government inserted in its Constitution a promise not to enter into foreign relations with any other country without the consent of the United States and accepted other conditions which materially impair its independence.

PROTEIDÆ, a family of large Urodele or long-tailed amphibians characterized by three pairs of persistent gills besides lungs, the presence of both fore and hind legs, the absence of eyelids and maxillary bones and the presence of teeth on the premaxillaries, the vomers and the mandible. The vertebræ are amphicoelars. The family contains three genera, each containing one species. These are Necturus, common in the eastern Mississippi Basin, the blind Proteus (q.v.), and the likewise blind *Typhlomolge*, found in artesian waters from Texas. The *Proteidæ* are often known as mud-puppies. (See AMPHIBIA; URODEL). For the development of this group see EMBRYOLOGY.

PROTEINS, a large group of organic compounds, of which the white of egg or ovalbumin, may be taken as a typical example. They make up the principal bulk of the solid matter of all animal cells and tissues, and are found in various parts of the structure of plants, especially in seeds. The proteins found in nature are 40 or 50 in number, mostly amorphous and indiffusible, and possess a complex chemical structure, whose nature is not clearly understood. They appear as non-crystallizable compounds of carbon, hydrogen, nitrogen, oxygen, generally, but not always, sulphur, and sometimes phosphorus; and occurring in a solid viscous condition, or in solution. Iodine is a usual constituent of the proteins found in marine animals. The different members of the group present differences in physical, and to a certain extent in chemical, properties; they all possess, however, certain common chemical reactions, and are united by a close genetic relationship. Thus, carbon is present in amount varying only from 50 to 55 per cent; hydrogen, from 6.9 to 7.2 per cent; oxygen, from 19 to 24 per cent; nitrogen, from 18 to 19 per cent; and sulphur, from 0.3 to 2.4 per cent — keratin of human hair, being a notable exception, having a sulphur content of 5 per cent. Proteins occurring in the vegetable kingdom are built up from simpler compounds; but the animal system is believed to be incapable of performing a synthesis of this kind, and the proteins that occur in the animal body are believed to be derived wholly by a modification of those that are taken into the system in the form of food. The proteins in the food are largely converted, by the action of such digestive ferments as pepsin and pancreatin, into soluble substances known as «peptones,» and these, after absorption through the intestinal walls, are (in large measure) transformed into the proteins that normally occur in the muscles and other tissues of the animal. Some of the protein portion of the food is, however, apparently transformed, in the course of digestion and assimilation, into glycogen and fat. In the changes which are inseparably associated with the life of the animal, the proteins that are stored in the body (and especially those in the muscular and nervous system) undergo a process of oxidation, or slow combustion, by which they are transformed into other compounds that are much less highly organized; the ultimate products of this oxidation being mainly water, carbon dioxide and urea.

The proteins, as a class, are so similar to one another in their ultimate composition, that Gerhardt believed them to consist mainly of one fundamental albumen-like substance, mingled, or perhaps chemically combined, with varying amounts of inorganic matter. This view is not in favor among the chemists of today.

Efforts to determine the molecular weights of the proteins have been many, and not at all satisfying. The results obtained, while quite indefinite, seem to prove that the molecular weights of the proteins are very large as compared with those which have been determined for other substances. For example, the molecular weight of egg-albumen, as obtained by the freezing-point method, is given as 14,270; that of hemoglobin, as determined by the iron content method, as 14,000.

Chemically, proteins exhibit a wide variance, some being distinctly acid and others decided bases which form strong salts with strong acids. The most of them, however, are neither markedly acid nor basic, but react toward acids as bases and as acids toward bases. Recent investigation of the proteins has been chiefly along the line of hydrolysis, accomplished by heating them with concentrated hydrochloric acid or strong sulphuric acid. A large number of amino-acids have thus been obtained from the simple proteins, but with the very unsatisfactory disappearance of about 30 per cent of the protein substance treated.

Though the proteins are mostly amorphous, a few are known that are capable of crystallization, notably some which have been obtained from the seeds of hemp and the pumpkin, from Brazil nuts and from castor-oil beans. Some other proteins which are not found in nature in a crystallized form can be obtained in that phase by special treatment. Thus, if egg-albumen is precipitated from its solution by ammonium sulphate and acetic acid, and allowed to stand, it gradually crystallizes. All the proteins are insoluble in absolute alcohol, but many of them are soluble in water, or in dilute saline solutions. Dissolved proteins all rotate the plane of polarization of polarized light to the left, the extent of the rotation varying with the nature of the dissolved protein. Dissolved proteins are not diffusible, as a rule, and mineral matters with which they may be mixed can, therefore, be removed by placing the solution in a vessel which is separated into two parts by a vertical porous membrane, pure water being placed in one compartment, while the solution to be dialyzed is placed in the other. The mineral salts will diffuse through the porous membrane, while the protein remains in the compartment in which it was originally placed. By renewing the water in the second compartment from time to time, the dialysis may be caused to proceed until practically the last trace of mineral matter has been removed from the protein. The peptones, however, are themselves diffusible, and the proteoses (or «albuminoses») are so to a lesser extent.

Many of the proteins that are soluble are precipitated from their solutions in a permanently insoluble condition by the action of heat, the substance which is thus thrown down being known as «coagulated protein.» The temperature at which heat-coagulation takes place varies with the nature of the protein, and (to some slight extent) with the degree of acidity or alkalinity of the solvent from which they are thrown down. The fibrinogen of the blood, for example, coagulates at about 133° F.; while serum-albumin and egg-albumen coagulate at 162° F., and crystallin at 199° F. When a protein is precipitated from solution by heat, the liquid from which it was thrown down almost invariably has its alkalinity increased, or its acidity diminished. Dry proteins may be brought into the «coagulated» condition by raising their temperature to 230° F. Raised to higher temperatures they carbonize, and evolve gases.

Coagulated proteins are exceedingly insoluble, and in fact cannot be brought into solution at all except by the action of some agent which changes their chemical nature profoundly. Pepsin (in an acid medium) or pancreatin (in an alkaline medium) convert them into soluble peptones, when the experiment is performed at a temperature not very close to that of the human body. A protein which is precipitated from its solution by alcohol is not at first thrown into the «coagulated» condition, but passes into it gradually upon prolonged contact with the alcohol. When a solution of proteins is saturated with ammonium sulphate, all of its proteins are precipitated except the peptones; but the precipitate is not in the coagulated form, for it is capable of dissolving again, either in pure water or in a dilute saline solution. This reagent is used, in the laboratory, for estimating the amount of protein in a given solution; the precipitate that it gives being removed by filtration; washed with a saturated solution of ammonium sulphate; heated to 230° to produce coagulation; and finally weighted, after the ammonium sulphate has been removed by thorough washing with pure water, and the precipitate has been dried. Many of the salts of the heavy metals (basic acetate of lead, for example), precipitate proteins from solution by forming, with them, an insoluble proteo-metallic compound. From this compound the metal may be subsequently removed by the action of sulphuretted hydrogen gas; the protein then being set free in its original, soluble state.

Of the chemical reactions manifested by the proteins as a class, the following may be especially mentioned: (1) *The xanthoproteic reaction.* When strong nitric acid is added to a solution containing a protein the protein is often (but not invariably) precipitated; and both the precipitate and the solvent turn yellow from the formation of xanthoproteic acid, the precipitate dissolving upon prolonged boiling, if the nitric acid is present in excess. The yellow color changes to an orange upon the addition of an excess of sodium hydroxide. (2) *Millon's reaction.* «Millon's reagent,» which is one of the best tests for detecting the presence of a protein, is prepared by dissolving mercury, by the aid of gentle heat, in an equal weight of nitric acid of specific gravity 1.4. When the metal has entirely dissolved, the solution is diluted with twice its bulk of water, and the abundant precipitate which comes down is allowed to subside. The clear liquid remaining is the reagent desired. Millon's reagent throws the proteins down in the form of a white precipitate; and both the precipitate and the solution become colored, ranging from pink in the cold to brick red upon boiling, though time is sometimes required before the coloration is complete. Solid proteins give this same reaction, when boiled with the test solution. Tyrosine and silk respond to it also. (3) *Sulphur reaction.* Warmed with a solution containing sodium hydroxide and a lead salt, a black precipitate or brownish color is produced in a solution of a protein containing sulphur, due to the formation of sulphide of lead.

The classification of the proteins has been essayed by several groups of students both in Europe and America, and the work, extremely difficult in itself, has been complicated by the use of terms to which different meanings have been attached by various writers. The American Society of Biological Chemists and the American Physiological Society have agreed on the following classification, which is regarded as standard by American students.

Simple Proteins.

Albumins.— Those which are soluble in pure water, and coagulate when heated.

Globulins.— Those which are insoluble in pure water, but dissolve in neutral solutions of salts derived from the action of strong acids upon strong bases.

Glutelins.— Those which are insoluble in all neutral solvents, but which dissolve in very dilute acids or very weak alkalies.

Prolamins (Alcohol-soluble proteins).— Those which are insoluble in water, neutral solvents and absolute alcohol, but dissolve in alcohol of 70 to 80 per cent strength.

Albuminoids.— Those which exhibit a high degree of resistance to solubility with all neutral solvents, while having apparently the same chemical structure as the soluble proteins.

Histones.— Those soluble in water and insoluble in ammonia (unless ammonia salts are present), which yield precipitates with solutions of other proteins, and, when heated, a coagulum readily soluble in very dilute acids.

Protamines.— Polypeptids simpler than the proteins of the groups above specified: soluble in water; not coagulated by heat; having the quality of precipitating water-solutions of other proteins; and exhibiting strong basic characteristics, forming stable salts with the strong mineral acids.

Conjugated Proteins.

Nucleoproteins.— Compounds of one or more protein molecules with nucleic acid.

Glycoproteins.— Compounds of the protein molecule with one or more substances containing a carbohydrate group other than a nucleic acid.

Phosphoproteins.— Compounds of the protein molecule with phosphorus-containing substance other than a nucleic acid or the lecithins.

Hemoglobins.— Compounds of the protein molecule with hematin, or similar substance.

Lecithoproteins.— Compounds of the protein molecule with the lecithins.

Derived Proteins.

Primary Protein Derivatives.— Those formed from the protein molecule apparently through hydrolytic changes, with but slight alteration in the protein molecule: embracing (1) Proteins — insoluble products of the action of water, very dilute acids or enzymes; (2) Metaproteins — products of such action of acids and alkalis as alters the molecule, forming substances soluble in very weak acids and alkalis, but not soluble in neutral solvents (including the so-called acid-albuminates and alkali-albuminates); (3) Coagulated Proteins — insoluble products resulting from the application of heat to their solutions, or to the action of the alcohols on proteins.

Secondary Protein Derivatives.— Products of a more extended cleavage of the protein molecule: embracing (1) the Proteoses — those which are soluble in water; not coagulated by heat; and which are precipitated by saturating their solutions with ammonium sulphate or zinc sulphate; (2) the Peptones — those soluble in water; not coagulated by heat; but not precipitated by saturating their solutions with ammonium sulphate; (3) Peptids — those compounds of definite structure in which two or more amino-acids are combined through the union of the carboxyl group of one with the amino group of the other and the loss of a molecule of water.

Albumins.— Serum-albumins have been separated from the lymph and blood-serum of vertebrate animals, from milk and from certain seeds. Lact-albumin is found in milk though in the small proportion of less than one-half of 1 per cent. The principal vegetable albumins are leucosin — found in wheat, rye and barley; and legumelin — of peas, beans and lentils.

Globulins are found in blood-serum and in certain body tissues and organs and in eggs, milk, seeds, etc. A typical globulin is fibrinogen, found in the blood of vertebrate animals. Upon being separated from the living animal the fibrinogen is almost immediately changed into fibrin or blood-clot by the action of an attendant enzyme. Musculin and myogen are globulins found in the tissue of what are known as a striped muscle. It is the coagulation of musculin after death which produces the stiffening of a corpse, known as *rigor mortis*.

Glutelins and **Prolamins** are found in the grains, a familiar example being the gluten of wheat, which is a mixture of glutenin, a glutelin; and gliadin, a prolamin. Zein, of Indian corn, is another example of the same group.

Albuminoids.— In this group are found the protein substances which in large measure give stability to the structure of the animal body. Collagen is a typical example. It is the foundation of cartilage and connective tissue and enters largely into the bony skeleton. When boiled in water, collagen yields gelatin. When treated with tannic acid, as in the making of leather, it becomes tough and highly resistant to decay. To this group belong also keratin, the principal substance of hair, horns, hoofs and feathers; and elastin, the largest constituent of the ligaments of the animal body.

Histones.— The most familiar example of this division of the proteins is globin, the protein constituent of the red coloring matter of the blood, hemoglobin.

Nucleoproteins are comparatively numerous, forming the chief constituents of the nuclei of all nucleated cells and hence found in every part of the body and its organs. They are found also in yeast and in certain plants.

Glycoproteins.—A common example of this group is mucin, a constituent of the saliva. As previously noted, egg-albumen is probably to be classed in this group; and here belong also the mucoids of egg-albumen and blood-serum.

Phosphoproteins.— The most familiar example is the casein of milk, regarded as a calcium salt in combination with calcium phosphate. When casein is coagulated with rennet, the product is paracasein, differing from casein chiefly in that its calcium salt is insoluble. Vitellin, found in the yelks of hen eggs, is another example of the phosphoproteins.

Hemoglobins.— The red corpuscles of the blood have a very large content of hemoglobin. When human blood is dried, the proper proportion of hemoglobin in the red corpuscles is found to be about 94 per cent. Either acids or alkalis reduce hemoglobin to the histone globin and the iron compound hematin, which is not a protein, but a derivative of pyrrole, one of the decomposition products of the proteins.

Albuminates belong to the group Metaproteins. They result from the so-called «acid albumin,» obtained by treating an albumin or a globulin with dilute acetic or hydrochloric acid. Acid albumin is soluble in dilute acids or alkalis, but insoluble in a neutral mentsruum. When the original protein is treated with a small quantity of dilute alkali, it combines with the alkali to form «alkali albumin»; and this, like acid albumin, is soluble in weakly acid or alkaline media, but insoluble in a neutral one. Alkali albumin is likewise not coagulable by heat. The combinations here described may be taken as typical of the albuminates in a general way; but as the albuminates are doubtless very numerous and as they have not yet been fully investigated, it must not be inferred that they will all possess the characteristics of ordinary acid and alkali albuminates.

Proteoses and Albumoses.— Proteins derived from the albumins or globulins or albuminates by the action of digestive ferments, such as pepsin and trypsin. They are intermediate between the original proteins and the peptones into which these original proteins are ultimately transformed by the digestive ferments. They are precipitated from solution by nitric acid, the precipitate dissolving upon application of heat. They are also somewhat diffusible, but not to the same extent as the peptones.

Peptones.— Proteins which are formed by the prolonged action of digestive ferments upon other proteins. (Compare the *proteoses* in the preceding paragraph). While they are not precipitated by heat, nor by nitric acid, they are precipitated by tannin and by certain other reagents. It seems quite clear that peptones are polypeptids. The peptones are diffusible and they play an exceedingly important part in digestion and assimilation. Peptones that are artifically prepared are commonly bitter, perhaps from the development of alkaloids or glucosides. Pure peptone has a meaty flavor.

Peptids.— The majority of peptids dissolve readily in water but not in alcohol. A few which are almost insoluble in water dissolve in acids or in alkalis. Most of them have a bitter taste. When heated with concentrated hydrochloric acid for several hours they are completely resolved into amino-acids.

Through this system of investigation it is hoped ultimately to discover the process of the upbuilding of the whole class of proteins from their primal elements.

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PROTERANTHUS. See GILLENIA.

PROTEROGLYPHA, a division of the Colubridæ family of snakes, in which the grooved poison teeth or fangs are attached to the forward part of the upper jaw — those in which the fangs are at the rearward part of the jaw being known as Opisthoglypha (q.v.). The group includes nearly all the more deadly of poisonous snakes.

PROTEROZOIC (Greek *proteros*, early, and *zoa*, life), a geologic time division generally given the rank of an era. According to the United States Geological Survey it includes all time before the Paleozoic, and is divided into the Archean and Algonkian periods. Other geologists divide the time before the Paleozoic into two eras, the Archeozoic (Archean) and Proterozoic (Algonkian). This article follows geological survey usage. Proterozoic time is also frequently referred to as the Pre-Cambrian. The type sections are in the region of the Great Lakes, in northern United States and Canada. The rocks of the era readily fall into two systems, the Archean (q.v.) and Algonkian (q.v.), separated by a profound unconformity. The former are dominantly igneous, consisting of a great series of basic lava flows and minor amounts of interbedded sediment, cut by large granite intrusions. This period of volcanism was followed by long erosion, and Algonkian rocks, dominantly sedimentary, were laid down on eroded Archean surfaces. Little is known of the geography of either period, except that in Algonkian time considerable limestone was deposited, pointing to probable submergence under an ocean. It is believed that glaciers occupied parts of Canada in the early Algonkian, and in the latter part of the period volcanism was again extensive.

There are no direct evidences of life in the Archean nor in the early Algonkian though limestones may point to the existence of minute lime-secreting animals. A few imperfect fossils, probably brachiopods and crustaceans, have been found in very late Algonkian rocks. Two similar rock systems, under various names, are recognized in Europe and probably in other continents. The intense metamorphism that Proterozoic rocks have undergone in many regions makes it impossible to separate the two systems over much of the world, at least until much more detailed work is done.

PROTESILAUS, prō-tĕs-ĭ-lā'ŭs, Greek hero, son of Iphiclus, king of Phylace, Thessaly. He led a band of Thessalian warriors against Troy and was the first of the Greeks to land on the Trojan coast, whereupon he was killed by Hector. Another tradition makes Achates slay him. He is famed in ancient story for the affection which existed between him and his wife, Laodamia, who, when she learned of his death, prayed that he might return to her for three hours. The prayer was granted and Hermes conducted Protesilaus to the upper world. At the end of the three hours Laodamia died with her husband and returned with him to the lower regions. However, there are also some other versions of his life and death. His tomb was near Eleus in the Thracian Chersonesus, a temple was erected to him there, and at Phylace a sanctuary was built in which funeral games were played in his honor. The story is told by Wordsworth in one of his most beautiful poems, 'Laodamia,' written in 1814. It was also the subject of a tragedy by Euripides of which only some fragments remain. In more recent times the Polish poet, S. Wyspianski, wrote a tragedy in verse (Krakow 1901) which has been translated into French by A. de Lada and L. Maury as 'Protésilas et Laodamie' (Paris 1913). Two ancient Roman sarcophagi, showing the history of the hero's life and death, have been preserved, one in the Vatican and the other in the church of Santa Chiara at Naples. Consult Preller, L., 'Griechische Mythologie' (2 vols., Berlin 1872–75); Roscher, W. H., ed., 'Ausführlichen Lexikon der griechischen und römischen Mythologie' (Vol. III, pt. 2, p. 3155, Leipzig 1902–09).

PROTEST, a solemn declaration of opinion, commonly against some act, particularly a formal and solemn declaration in writing of dissent from the proceedings of a legislative body, or a like declaration of dissent by a minority of any body against the proceedings of the majority. In the commercial usage of the term, a protest is a formal declaration, made by a notary public, under hand and seal, at the request of the payee or holder of a bill of exchange for non-acceptance, or non-payment of the same, protesting against the drawer and others concerned for the exchange, charges, damages and interest. This protest is written on a copy of the bill of exchange, and notice is given to the drawer and endorsers of the same, by which they become liable to pay the amount of the bill, with charges, damages and interest. To be of legal effect the action of the notary must be taken on the day the payment was due. (See BILL — BILL OF EXCHANGE). A protest is also a writing, attested before a notary public, a justice of the peace or a consul in foreign parts, drawn by a master of a vessel, stating the severity of a voyage by which the ship has suffered, and protesting that the damage was not owing to the neglect or misconduct of the master.

PROTESTANT EPISCOPAL CHURCH, The, the American branch of the Anglican Communion. The Church in America, though quite independent, is in full communion with the Church of England and inherits her ecclesiastical position. As the Preface to the Prayer Book states: "This Church is far from intending to depart from the Church of England in any essential point of doctrine, discipline or worship; or further than local circumstances require." To define her principles and position is to define Anglicanism, to interpret that movement in history known as the English Reformation.

In the beginning of the 16th century the Church of England was in full communion with the national churches of western Europe, acquiescing with them in the headship of the Church of Rome. In doctrine and discipline she had become identified with the prevailing type of Latin Christianity. By the end of the 17 century she had withdrawn from the Roman obedience and had gradually come to assume the position she maintains to-day. This period of transition constituted the Anglican Reformation. The status of the Church of England was unique. Positively, the change involved a reassertion of the principles of primitive Christianity and an assimilation of the newly-awakened tendencies of modern thought. Negatively, it involved the repudiation on the one hand of mediæval Roman Catholicism, on the other of Continental Protestantism. Anglicans believed that the change involved no breach in the continuity of the English Church. They maintained that in rejecting much that was Roman and mediæval they had forfeited nothing essentially catholic.

The American Church inheriting this position claims to be a branch of the primitive Catholic and Apostolic Church. At the same time she is frankly opportunist in adapting herself to the needs and conditions of modern life. In the sense of being not-Roman, she is Protestant. As maintaining that her continuity with the ancient Church is guaranteed by her possession of the Apostolic succession of bishops, she is Episcopal. She is Episcopal also in the sense of being not-Papal. This, perhaps, gives the rationale of her common legal title. Members of the Church are spoken of indifferently as Anglicans, Episcopalians or Churchmen.

The fundamental principles of Anglicanism as well as Anglican terms of inter-communion are indicated in what is known as the Chicago-Lambeth Quadrilateral. In 1886 a Commission on Christian Unity reported to a General Convention held at Chicago. The substance of their report was embodied in a Declaration of the House of Bishops. Two years later this Declaration was, with slight modifications, adopted by the bishops of the whole Anglican Communion, meeting in conference at the archbishop of Canterbury's palace in Lambeth. The wording of this Anglican Eirenicon, defining the essentials of the Christian faith, is as follows:

"1. The Holy Scriptures of the Old and New Testaments, as containing all things necessary to salvation, and as being the rule and ultimate standard of faith;

"2. The Apostles' Creed, as the Baptismal Symbol, and the Nicene Creed, as the sufficient statement of the Christian Faith;

"3. The two Sacraments, ordained by Christ Himself — Baptism and the Supper of the Lord — ministered with unfailing use of Christ's words of institution and of the elements ordained by Him;

"4. The Historic Episcopate locally adapted in the methods of its administration to the varying needs of the nations and peoples called of God into the Unity of His Church."

This declaration may be taken as an official indication of the bases of the Anglican position.

It is the belief and hope of Anglicans that the position gives them good vantage-ground for promoting the cause of Christian unity. They have much in common with all bodies of Christians. While their attitude toward Roman Catholics is one of resolute protest, their quarrel is only with a mediæval Romanism by which they believe that the primitive Catholicism of the great Latin Communion has been obscured. Their position more nearly approximates that of Eastern Orthodox Catholicism — Greek Christianity — and that of the Old Catholics. Their relations with both these communions are those of friendly interest and intelligent sympathy, although there is no inter-communion nor immediate prospect of it. The many differences due to widely differing antecedents oppose difficulties to the adoption of a common platform. This, however, does not prevent many manifestations of present friendship and hope of closer relations in future. Recent years have seen a marked rapprochement between the Anglicans and the Russian Orthodox Communion.

On the other hand, the Anglican Church is in close sympathy with the life and aims of various bodies of Protestants. Her breach with the Christian past is not so great as theirs but she rejoices to feel that the fundamentals of her faith are the same as theirs, and that she is at one with them in striving to adopt and apply Christianity to the needs of modern times. Since the appointment of a Commission on Christian Unity in 1856 there have been conferences with the Presbyterian General Assembly, the General Synods of Evangelical Lutherans of the North and South and the Provincial Council of the Moravians. These have contributed somewhat to a better mutual understanding. Some idea of the nature of the Anglican claim and hope is necessary at the outset for an appreciation of the details of Anglican history.

The Church of England in the American Colonies.— The Church of England came to America with the first English explorers and colonists. The first English service, so far as is known, was held in 1579 on the coast of California by the Rev. Francis (or Martin) Fletcher, ship's chaplain to Sir Francis Drake. In 1607 an English clergyman was regularly established among the Virginia colonists at Jamestown. This missionary was the Rev. Robert Hunt, a man of simple piety and great zeal, who held daily services in the open air, and on 21 June 1607 for the first time in America administered the Holy Communion. Virginia was a Church of England colony. Various missions were established as the colony grew. The clergy were most of them faithful missionary priests. Some, unfortunately, were men who had bad records at home, and whose lives tended to discredit the Church which they served. In the same year that Jamestown was settled, Prayer-Book services were held also on Saint George's Island, Maine. Within a short time there were English clergymen settled in Maryland, and before the end of the century missionaries working in New Hampshire, South Carolina, Delaware, New York, New Jersey and Pennsylvania. In 1692 grants of land were made for Trinity Church, New York. Five years later the Rev. William Vesey was established as rector of what has become the most important parish in the country.

In New England the Church of England fared badly. The Puritans of Massachusetts Bay had on leaving England professed unalterable attachment to their mother-church. They had, however, adopted a Calvinistic theology differing in various ways from the teaching of the Prayer Book. Shortly after reaching New England, they adopted also the ecclesiastical polity of the Pilgrims of Plymouth. In England, Puritans as well as Anglicans had done their best to suppress "Independents." Calvinistic Congregationalism became the "standing order" in Massachusetts and Connecticut. The use of the English Prayer Book was made a penal offense and Churchmen, so far as possible were driven from the colonies. Among the more notable victims of Puritan intolerance were John Checkley, William Blackstone, the Browns of Salem and Samuel Maverick. Some took refuge in Rhode Island, others in colonies farther south.

The 18th century saw increased effort on the part of the Church of England to minister to the needs of colonists in America. Since 1634 colonial churches had been under the supervision of the bishop of London. In 1696 Bishop Compton of London appointed as his "commissary" for Maryland, Dr. Thomas Bray. Dr. Bray's interest in American missions led to the formation of the Society for Promoting Christian Knowledge (S. P. C. K.) and of the Society for the Propagation of the Gospel in Foreign Parts (S. P. G.). This latter society was especially active in providing missionaries for America, and in furnishing them with means of support. The most notable of these missionaries were the Rev. George Keith and the Rev. John Talbot. They traversed the colonies from New Hampshire to North Carolina and sent to the S. P. G. full reports of the needs of America.

English clergy met with much opposition in New England. There was a special outcry against them owing to secession from the Congregational ranks. In 1722 the president of Yale College, Dr. Timothy Cutler, and four tutors resigned their position to embrace Episcopacy. One of these, Dr. Samuel Johnson of Stratford, became the most notable Churchman in Connecticut. One of the wisest and most far-seeing friends of America in England was Dr. George Berkeley, dean of Derry, afterward bishop of Cloyne. He wished to found a training school for American missionaries. "Saint Paul's College" was to have been situated in — it being a conveniently central point — the Bermuda Islands. Dean Berkeley came to America and spent three years in Rhode Island. He was forced to abandon his project by failure to receive funds which had been promised by the English Parliament.

John and Charles Wesley for a time worked in Georgia in the early days of the colony. This was before any Methodist societies had separated from the English Church. Later Methodist preachers, especially George Whitefield, were vehement in denouncing the Anglican clergy and did much to disturb the S. P. G. missions. However, the work prospered despite drawbacks — greatest of which was the lack of bishops — and by 1775 there were about 300 parishes, ministered to by 250 clergymen. It is estimated that between 1607 and 1775 about 2,000 "Clerks in Holy Orders" of the English Church had, for longer or shorter periods, labored in America.

Organization as an Independent Church. — The outbreak of the War of the Revolution put an end to intercourse between colonial Churchmen and the authorities of the Church of England. Many of the clergy were Tories. These left the colonies for England and Nova Scotia. During the war services were maintained in a few places, prayer for Congress being substituted for prayers for the king. The one man whose influence did most to hold together scattered bands of Churchmen was Dr. William White of Christ Church and Saint Peter's, Philadelphia. He was in close touch with the fathers of the Commonwealth and was for many years chaplain of Congress. Immediately after the recognition of American independence steps were taken to organize an independent American Church and to establish new relations with the Church of England, which should recognize «the Change in our Situation from a Daughter- to a Sister-Church.»

First to act — for themselves alone — were the clergy of Connecticut. They were convinced that the first step of all must be to obtain bishops. In 1783 a meeting was held at Woodbury, at which a petition was addressed to English bishops to consecrate for America and a candidate was chosen for the episcopal office. The bishop-elect was Dr. Samuel Seabury, a native of Connecticut, an S. P. G. missionary in the colony of New York and a chaplain in the British army. He sailed to England and asked for consecration. This he was unable to obtain. The English bishops, as officers of a state-church, were unwilling to act without formal authorization by Parliament. This was not forthcoming. After waiting a year Seabury, in compliance with instructions from Connecticut, transferred his application to the Episcopal Church of Scotland. The Scottish bishops willingly granted his request and he was consecrated in Aberdeen 14 Nov. 1784. He signed a «concordate» with his consecrators, in which inter-alia it was agreed that he should use his influence to introduce in America a Communion Office like the Scottish. This differs from the English one, being in some ways «more agreeable to the genuine Standards of Antiquity.» Five years later Bishop Seabury was enabled to keep this promise. His enduring monument is the complete form in the American Prayer Book of the Prayer of Consecration in the Eucharistic Office. Bishop Seabury lived until 1796. He was a noble man and a staunch Churchman. He was indefatigable in administering his diocese, but, partly owing to his «war record,» did not exercise great influence outside of Connecticut. It was not until a century after his death that his fellow-Churchmen fully appreciated the extent of their indebtedness to this first of all bishops in America.

In 1785 delegates from seven colonies south of Connecticut, laymen as well as clergymen, met in convention in Philadelphia. Their most important acts were to arrange for triennial General Conventions, and to make a new application to the archbishops of England to consecrate bishops for America. There was some delay. The English bishops objected to proposed changes in the Prayer Book. Their objections were met by action of a convention held in Wilmington, Del., in 1786. Finally, on 4 Feb. 1787, English bishops in Lambeth Chapel consecrated Dr. William White to be bishop of Pennsylvania and Dr. Samuel Provoost to be bishop of New York. Four years later, Dr. James Madison, president of William and Mary College, was consecrated, in England, bishop of Virginia. The four American bishops in 1792 joined in the consecration of Thomas John Claggett, as bishop of Maryland, through whom the joint succession from the bishops of England and Scotland has passed to every member of the American episcopate.

The bishops of the Church are its chief officers, but the «Constitution and Canons,» adopted in 1789, provide that presbyters and laymen shall share their responsibility of administration. Each diocese has a standing committee, consisting of presbyters and laymen (in three dioceses, of clergy only) elected by the diocesan convention. This committee acts as a cabinet to the bishop. In case of vacancy in the episcopate, or sometimes during a bishop's absence or incapacity, the standing committee for canonical purposes becomes the «Ecclesiastical Authority» for the diocese.

Similarly, the House of Bishops is associated with a House of Deputies in General Convention. The lower House is composed of four clerical and four lay delegates (communicants) from each diocese and one clerical and one lay delegate from each missionary jurisdiction. Either House may originate legislation, but concurrent action is necessary to make it valid. The House of Bishops has a veto on the action of the lower House. All bishops are equal in rank. The senior by consecration acts as primate or «Presiding Bishop.» All general disciplinary regulations are comprised in the Constitution and Canons of the General Convention. In addition to these, each diocese has its own constitution and canons.

A general convention was held in 1789. Bishop Provoost and some delegates objected to the recognition of Bishop Seabury, but the objection was overcome by the influence of Bishop White. As Bishop Provoost was absent, Bishop Seabury and Bishop White constituted the first House of Bishops. Their chief work was the revision of the Prayer Book. All proposed changes emanated from the bishops and, with one exception, were ratified by the House of Deputies. The two bishops formed an effective combination. To quote an apt comment of Bishop John Williams: «For the results of that memorable Convention, in which so much was gained — may we not say so little lost? — we are indebted under the over-ruling wisdom of the Holy Spirit to the steadfast gentleness of Bishop White and the gentle steadfastness of Bishop Seabury.»

The Prayer Book adopted in 1789 (to which a few additional offices were later added) continued in use for over a century. In 1892 a second revision was completed when the Prayer Book was given its present form. This Prayer Book, which contains all the public offices of the Church, is the best evidence of the doctrinal and ecclesiastical position of the Protestant Episcopal Church. Canons give regulations for practical administration, discipline and clerical education. They give a fair idea of the Church's methods of working. The Prayer Book alone can suggest the faith and spirit which constitute her life.

History during the 19th Century.— For 50 years the Episcopal Church was a small body. It could do little more than assert its right to exist in the face of hostile prejudice. It was suspected for its English antecedents and disliked for its assertion — distinct though timid — of ancient ecclesiastical principles in the midst of prevalent Protestantism. It was perforce apologetically apostolic. It was inevitable, however, that it should gain a firm footing in American life, when its representatives were such clergy as its first bishops and such laity as Washington, Jefferson, Hamilton, Franklin and two-thirds of the signers of the Declaration of Independence. For 50 years the most conspicuous figure in the Church was that of Bishop

White. His episcopate (1787–1836) was the most important the Church has seen. His wise and gentle guidance of his own people, his fairness and charity toward all others, did much to protect the Church in the critical period of its history.

There were other strong men in the House of Bishops. John Henry Hobart of New York (1775–1830) had the most forcible personality. He was, as his epitaph states, "the able and intrepid Champion of the Church of God." He was enthusiastically loyal to the principles of his Church and saw no wisdom or charity in hesitating to avow them. "Evangelical Truth and Apostolic Order" was his motto. No Churchman of this time did so much to make explicit the principles of Anglican Catholicism.

Alexander Viets Griswold (1766–1843) of the Eastern Diocese (all New England except Connecticut) was influential in a different way. He possessed New England virtues, a serious piety, patient hardihood and frugality and a great capacity for hard work. His faithful ministrations in all parts of his immense diocese did much to dispel Puritan supersition concerning Episcopacy and the episcopal order.

Philander Chase of New Hampshire (1775–1852), first bishop of Ohio and later of Illinois, labored indefatigably as a missionary in many States. He was founder of Kenyon College and Bexley Hall, Gambier, Ohio, and Jubilee College, Peoria, Ill. For both of these he obtained funds in England. He was of an eccentric character, but a man of determination. His one aim was to spread the knowledge of his own two treasures, the Bible and the Prayer Book. These men were typical American Churchmen of the first half of the 19th century. their work indicates very fairly the kind of work done by their fellow-Churchmen in all parts of the country.

Parties.— The work of the Church has been largely missionary; its clergy, men of affairs rather than theologians. It has produced no peculiar school of thought, but has reflected the theological developments of England and Germany. There have been, generally speaking, three types of Churchmen, known respectively as High Church, Low Church and Broad Church. Each of these has emphasized some one side of Church teaching and has not escaped the dangers of one-sided partisanship.

The Low Church represented the 18th century revival in the Church of England which took the form of Evangelicalism within the Church and Methodism without. The truths which it emphasized were the absolute dependence of the spiritual life on the person of Christ, the need of conversion, the reality of grace and purely instrumental character of "ordinances." The Atonement was the central fact in Evangelical theology. (Men of this school were also noted for promoting the cause of foreign missions). The Evangelicals were dominant until the middle of the 19th century. They were strenuous in opposing High Church teaching as being thinly disguised "Popery."

High Church principles were brought to the fore by the Tractarian (Oxford) Movement which began in 1833. These were the assertion of the character of the Church as a divine society, the special sphere of the working of the Holy Spirit; of the character of sacraments as veritable means of grace; of the central place in Christian worship of the Holy Eucharist. Among the more obvious results in this movement were increased reverence and beauty in church services, increased parochial activity, especially among the poor; the revival of frequent Eucharists and (to some extent) of auricular confession. The later stages of the movement produced a party of Ritualists. They differed from the early Tractarians. Their ritual was largely in imitation of the Latin rite, whereas their predecessors copied a Laudian model; their ideals were mediæval rather than patristic. The early Tractarians sought to revive the teachings and spirit of the first four centuries, the ritualists to reproduce the picturesque externals of the 14th. Both sections of the party emphasized the "sacramental principle" in Christianity and made the Incarnation rather than the Atonement the central fact in their theology.

Parallel with the Oxford Movement was the development of what is variously described as the Liberal Theology or Latitudinarianism. The Broad Church platform is based on the fundamental truth of the Fatherhood of God. It is well described in words of its most distinguished American representative, Phillips Brooks: "The broader theology, which had its masters in England in such men as Dr. Arnold and the Rev. Frederick D. Maurice, has likewise had its clear and powerful effect upon the Episcopal Church. A lofty belief in man's spiritual possibilities, a large hope for man's eternal destinies, a desire for the careful and critical study of the Bible, and an earnest insistance on the comprehensive character of the Church of Christ — These are the characteristics of much of the most zealous pulpit teaching and parish life in these later days." Broad Churchmen desire to vindicate the rational character of Christianity, to develop its philosophic side, to bring formal statements of the faith into accord with modern knowledge and modern thought. They find themselves much in sympathy with the early theology of Alexandria and more or less opposed to the type of mind represented by Augustine.

There has been conflict between representatives of these several schools, not concerning positive principles but concerning their respective negations. Too often zeal for a half-truth has denied or disparaged another half-truth. In retrospect it seems easy to see that the special principles of the three schools are equally part of the Church's teaching. The difference between them is largely one of emphasis. They divide the Creed between them. The Church Catechism contains a question, "What dost thou chiefly learn by these articles of thy belief?" The answer is: "First, I learn to believe in God the Father, who hath made me and all of the world; secondly, in God the Son, who hath redeemed me and all mankind; thirdly, in God the Holy Ghost, who sanctifieth me and all the people of God." This suggests a generalization which may characterize High, Low and Broad Church. Each has emphasized one section of the Creed, and, at times, failed to do justice to the others. The Broad Church are concerned for the Fatherhood of God, the moral and philosophical basis of Christian truth. The Low Church are chiefly concerned to present Christ as Redeemer and the Centre of all their thought. The High Church have had to emphasize a neglected portion of the Creed, belief in the Holy Ghost, the Sanctifier, in Church and Sacraments as ordained means of union with Christ. The best men of the various schools have never been mere partisans. Party-lines are now less clearly defined. The tendency is to combine truths, to cultivate an all-round Churchmanship, which has more than one dimension.

Controversy.— For over 30 years, Churchmen were more or less disturbed by discussions aroused by the Tractarian Movement. American Low Churchmen were strongly opposed to the «Oxford Divinity.» The first important incident in the agitation was the «Carey ordination» in 1842. Arthur Carey, a graduate of the General Theological Seminary, who had accepted Tractarian principles, was, in consequence, subjected to a severe examination by the chaplains of the bishop of New York. They declined to recommend him for orders. The bishop, Dr. B. T. Onderdonk, himself examined the candidate, was satisfied with his answers and proceeded to his ordination. This occasioned an outcry against the bishop and was the signal for a series of disputes and campaigns of pamphlet warfare, in various parts of the country. In many instances, Low Church bishops objected to the liking of High Church clergy for «awkward chancel-arrangements» suggestive of High Eucharistic doctrine. Bishop McIlvaine of Ohio refused to consecrate a church until the altar was removed from the east wall. Bishop Eastburn of Massachusetts refused to visit a Boston church for confirmations because the clergy kneeled facing the altar, which was surmounted by a cross and candlesticks. These were typical examples. There were discussions over vested choirs, preaching in surplice, stained-glass windows, flowers on the altar and similar details. There was also an effort made by Low Church partisans to discredit High Church doctrine by impugning the moral character of its leading champions. Partisan motives mingled with the laudable feeling that a bishop like the wife of Cæsar «must be above suspicion.»

A revival of controversy followed the Civil War. At two successive General Conventions, 1868 and 1871, the main discussion concerned a «Canon of Ritual.» Various proposals were made to forbid the use of ceremonies recently revived and behind this was opposition to Tractarian teaching on the sacraments. In the Convention of 1871, Dr. James De Koven of Racine College took a firm stand as champion of «the Real Presence» and challenged anyone to bring him to trial for erroneous doctrine. The challenge was not accepted. In 1875, however, because of his principles, the Church at large refused to confirm Dr. De Koven's election to the see of Illinois, as it had previously refused to confirm the election of Dean George F. Seymour. The Convention of 1874 passed a canon forbidding «ceremonies or practices not ordained or authorized in the Book of Common Prayer and setting forth or symbolizing erroneous or doubtful doctrines.» The accompanying discussion indicates that the framers had especially in mind «the doctrine commonly known as Transubstantiation.» In 1878 Dr. G. F. Seymour was elected bishop of Springfield. This time his election to the episcopate was confirmed by the Church. The event of his consecration marks the end of the effort to deny that High Church doctrine is in harmony with Anglican formularies. It marks also the end of a crusade against ritual as such, although the Church has consistently disapproved any attempt to supersede Anglican by Roman doctrine.

At the time of this later discussion occurred the secession of the «Reformed Episcopalians.» The occasion of this was a controversy over Baptismal Regeneration. A number of Churchmen who held Zwinglian views of sacraments objected to the wording of the baptismal office. They found a leader in the assistant bishop of Kentucky, Dr. G. D. Cummins. He issued a call for a conference of all who wished to reform the Church. The convention adopted an expurgated Prayer Book and organized as a new sect. Bishop Cummins was deposed by the House of Bishops. He continued, however, to act as bishop and consecrated as a colleague the Rev. C. E. Cheney, a deposed clergyman of the diocese of Illinois. Their following was never large and has now dwindled to insignificant proportions.

The Church of the Confederacy.— It is pleasant to turn to a striking episode in the Church's history where an unavoidable division was quickly and quietly healed. By the outbreak of the Civil War, Southern Churchmen were isolated from their Northern brethren. Their position was analogous to that of colonial Churchmen at the Revolution. There was this great difference that there were 11 organized dioceses, each with a bishop. These 11 dioceses eventually united to form the Protestant Episcopal Church of the Confederate States. For five years the Church of the Confederacy pursued its independent course. Bishop Polk of Louisiana, who had had a West Point education, assumed command of a Confederate army and was killed in battle. At the end of the war the Church was confronted with the difficult question of the relation of these severed parts. Some Northerners were anxious to take action which would have been very offensive to Southern susceptibilities. There were two specially difficult points, the precedent established by Bishop Polk and the case of Bishop Wilmer of Alabama, who had been consecrated during the war, without the consent of the Northern dioceses. Fortunately the wisdom of a few leaders, Hopkins of Vermont, Horatio Potter of New York and others, guided all to a satisfactory conclusion. The Convention of 1862 had ignored the absence of Southern delegates. In 1865 the Southern bishops were urged to attend and «trust to the love and honor of their brethren.» Two bishops and delegates from three dioceses responded. In the Convention of 1868, the South was fully represented. By exercise of tact and patience on both sides, Churchmen had succeeded in ignoring «the late unpleasantness.»

Christian Unity.— As has been already noted, the Episcopal Church believes that she has a special mission to promote Church Unity. For 50 years there has been a standing Commission to consider this subject. The occasion of its appointment was the presentation at the Convention of 1853 of a «Memorial» signed by Dr. W. A. Muhlenberg and other well-known clergymen. This «Memorial» made a plea for greater liturgical freedom and a less stringency in conferring Holy Orders. It aimed at taking «an important step toward the effecting of a Church unity in the Protestant Christendom of our land.» The first report of the Commission made valuable suggestions, but led to no immediate results. Important members of the Commission were Bishops George Burgess of Maine and Alonzo Potter of Pennsylvania. The discussion which ensued paved the way for subsequent Prayer Book revision and conferences with representatives of other Christian bodies. Part of the aim of the «Memorial» was realized in 1898 by the passage of the «Huntington Amendment.» This relaxes the obligation always to use the Prayer Book in public worship and recognizes the duty of bishops to provide special forms of service for special congregations and special occasions. Both «Memorial» and «Amendment» aim at making the Church freer for evangelistic work.

There is another side to this work for unity. Dr. Muhlenberg had in mind «the Protestant Christendom of our land.» There is a larger Christendom than this which the Church may not forget. Something has been done to establish friendly relations with Eastern Orthodox and Old Catholics. Bishop Horatio Southgate in 1843 was accredited, as representing the Church, to the patriarch of Constantinople; Dr. J. F. Young of New York (later bishop of Florida) in 1864, and Bishop Grafton of Fond du Lac, in 1903, have paid official visits to the Church in Russia. Bishop Whittingham of Maryland in 1872 attended the Old Catholic Conference in Cologne. Russian and Old Catholic bishops have on several occasions accepted the official courtesies of the American Church. Polish Old Catholics in America have made definite proposals of union. Another century may see some result from these small beginnings.

Missions.— The Episcopal Church has always been breaking ground in new fields. Her first duty was to extend her work in the Western States. Among the typical examples of the home missionaries were the Rt. Rev. Jackson Kemper, missionary bishop of the Northwest, and Dr. James Lloyd Breck. Dr. Breck with two friends founded Nashotah House in Wisconsin as a training school for missionaries. Later he removed to Minnesota, organized work among Indians at Crow Wing and laid foundations for Church institutions in Faribault. Bishop H. B. Whipple developed and completed his work. Still later Breck organized the «Associate Mission for the Pacific Coast.» His last work was the founding of schools in Benicia, Cal. The first bishops in the Pacific States were William Ingraham Kip of California and Thomas Fielding Scott of Oregon and Washington. Most of the Western States contain one or more organized dioceses. There are still 16 missionary jurisdictions in the United States and four others in American possessions. Bishops have been recently sent to Alaska, Sandwich Islands, the Philippines and Porto Rico.

There are six foreign missionary jurisdictions, Western Africa (Cape Palmas); Shanghai and Hankow in China; Tokio and Kioto in Japan, and Cuba. Bishops have also been consecrated for independent churches in Haiti, Mexico and Brazil. The direction of missionary work is entrusted to a Board of Missions with headquarters in New York. Contributions for missions of all kinds probably amount to a million dollars a year.

Institutions.— There are a number of Episcopalian theological schools. The General Theological Seminary in New York is a training school for the whole Church. It was founded in 1817, was removed for a time to New Haven, returned in 1820 to New York and was shortly after established in Chelsea Square. It owes its present buildings to generous gifts of Dean Eugene Augustus Hoffman. Of other seminaries, the more important are the Episcopal Theological School, Cambridge, Mass., Berkeley Divinity School, Middletown, Conn., the Divinity School of Philadelphia, Seabury Divinity School in Faribault and Nashotah House.

Trinity College, Hartford, Conn., Kenyon College, Gambier, Ohio, Hobart College, Geneva, N. Y., the University of the South, Sewanee, Tenn., and Saint Stephen's College, Annandale, N. Y., are all Episcopalian institutions. Columbia University, New York, always has a Churchman for president and uses Church prayers in its chapel. Lehigh University, South Bethlehem. Pa., is by direction of its founder under Church auspices. There are many diocesan schools for boys and girls and special schools for Negroes and Indians. Of the larger Church schools for boys may be mentioned Saint Paul's School. Concord, N. H., Groton School, Groton, Mass., and Racine College, in Wisconsin. Churchmen have always been active in promoting charitable work. Saint Luke's Hospital, New York, is a conspicuous example of their zeal. There are numerous organizations for the furthering of Church work and a number of religious orders for men and women.

The number of Churchmen is not large, but the rate of increase has been comparatively rapid. In 1800 there were 11 dioceses served by seven bishops and 208 other clergy; in 1916 there were 102 dioceses and missionary jurisdictions served by 122 bishops and about 5,800 other clergy. The number of communicants was about 1,060,000, a number which implies about 4,000,000 adherents.

The materials for the history of the Protestant Episcopal Church are to be found in Journals of the General Convention, the memoirs of distinguished Churchmen and collections of pamphlets in the libraries of Church institutions. Perry's 'History of the American Episcopal Church,' a collection of monographs, is the most complete formal history. There are smaller works by the Rt. Rev. Leighton Coleman, D.D., bishop of Delaware, the Rev. C. H. Tiffany, D.D., and the Rev. S. D. McConnell, D.D.

FREDERICK JOSEPH KINSMAN,
Bishop of Delaware.

PROTESTANTISM. The Diet of Worms (1521) placed Martin Luther, the friar of Wittenberg who had presumed to criticise the Pope and to condemn certain ecclesiastical practices of his day, under the ban of the empire. He had already been placed under the ban of the Church by Pope Leo X, and thus stood condemned by Church and State alike. But he had powerful supporters in Saxony and elsewhere and their influence was sufficient to protect him from personal harm and to promote his cause until, at the Diet of Speyer (1526), it was voted that each state of the empire should decide for itself whether the Edict of Worms should be enforced. This was the first step toward the legal toleration of the Lutheran faith. At the second Diet of Speyer (1529) this limited degree of toleration was withdrawn. Nineteen of the states of the empire protested against the reactionary measures of this Diet, and their formal protest caused them to be known as "Protestants." This is the historical origin of the name which is now commonly applied to all who in the 16th century broke away from papal Rome, and to their ecclesiastical successors down to modern times. The organized Christian world of the West has ever since been divided into two great groups, namely, Roman Catholics and Protestants. The countries where Greek Catholicism held sway took no part in the Reformation movement, and until recent times have remained for the most part uninfluenced by Protestantism.

The Protestant movement looks to Martin Luther (1483–1546) as its founder and chief leader, and to the University of Wittenberg as its original home. Luther's most notable early associate was Philip Melanchthon (1497–1560), a theologian and humanist, the author of the first Lutheran work on dogmatic theology, and the framer of the Augsburg Confession (1530). A well-known contemporary, Huldreich Zwingli (1484–1531),— also a very able and influential preacher against ecclesiastical abuses,— led an anti-papal movement of almost equal importance in German Switzerland, and there laid the foundations of the Reformed faith. The chief scene of his activities was the town of Zürich. The movement which Zwingli inaugurated was, however, overshadowed and absorbed by the more constructive work of John Calvin (1509–64), a Frenchman by birth, who made of Geneva a Protestant stronghold,— "Little Rome," as his opponents called it. From Geneva the principles of the Calvinistic Reformation went forth to many other European lands. They were carried into Scotland by John Knox (1505–72), and that country became an important factor in promoting the growth of the Reformed faith in the Anglo-Saxon world. The Protestant forces of Europe, called into life by these leaders and others hardly less important, fall into two main groups, commonly called by European historians the Lutheran and Reformed churches. The Lutherans were not only originally Teutonic, but for the most part have remained so. The Reformed, known in America more commonly as Calvinists, proved to be much more international in character. Among the Lutherans are included chiefly Germans, Danes and Scandinavians; among the Reformed, or Calvinists, are included Swiss, French, Dutch, English, Scotch, Irish and various minor nationalities found in America. Historians have sometimes attempted to account for the wider extension of the Calvinistic type of Protestantism by pointing out that it sanctioned the employment of force in maintaining the faith, which Luther never did except reluctantly, that it emphasized popular education, offered greater freedom from traditionalism (for instance in the interpretation of the Lord's Supper), and that it tended to separate Church and State. The Lutherans for the most part were organized throughout Germany into a series of state churches,— a natural outgrowth of the German political principle, *cujus regio ejus religio*. The Protestant princes exercised control over the churches within their respective jurisdictions, and although this power was usually delegated to an officer known as the superintendent (the Lutheran analogue to a bishop), yet in each case the prince himself was to a large degree the governor of the church.

Except in England, where ecclesiastical conditions were different, state control of religion among the followers of Calvin, even if it once existed, rarely lasted very long, for Calvinism always encouraged the growth of a republican type of government. One of the best examples of this growth is found in the French town of La Rochelle where a political as well as an ecclesiastical system was developed which for a time threatened the existence of royal absolutism in France. Although in not a few cases the Calvinistic régime produced intolerance, yet Calvinism itself was based upon a principle which sooner or later was bound to result in freedom. It would, therefore, be an error to assume that, because in Geneva or in Massachusetts Bay there existed a theocracy, there must of necessity be theocratic government wherever the principles of Calvin are taught.

Lutherans and Calvinists may further be distinguished from each other by their attitude toward the Bible. Generally speaking Lutherans believed that the Church might properly retain whatever doctrines or ceremonies were not obviously prohibited in Scripture. Calvinists on the other hand believed that only such doctrines and ceremonies should be retained as were expressly commanded there. The general principle of biblical authority was, to be sure, maintained in both churches, as over against the principle of ecclesiastical authority held by the Papacy, but the difference to which reference has just been made proved to have an important bearing upon the development of the two branches of Protestantism. It is obvious that the appeal to Scripture, constantly made by Protestants, contains within itself a corrective for such errors as might from time to time come into existence through its use. Thus the verbal authority of Scripture, upon which in the latter part of the 16th century not a few Protestants both Lutheran and Calvinist relied, gave place in time to a much less mechanical conception. The more the Bible was studied and the better it was understood, the less it showed itself to be a legal code and the more it came to be regarded as a history and source of spiritual and religious power. Modern critical study of the Bible, including what is commonly called the Higher Criticism, is a legitimate outgrowth of the Protestant principle of Scriptural authority.

The connection between Protestantism, as a religious movement, and politics is real and historically of the highest importance. In French Switzerland is to be found a model of the self-governing churches which belonged to the Calvinistic wing of the Reformation. That model was Geneva, where religion was the controlling influence, and where the ecclesiastical organization was hardly less significant than the civil. In the history of the Netherlands, as well as of Scotland and England, one may find constant illustration of the interplay of the same two forces. James I's famous declaration, "No bishop, no king," was not only true for the Stuart monarchy at the time, but also affords a key to the history of the relations between politics and religion throughout the 17th century. It was the spirit of self-government, exhibited among Presbyterians and Independents which inspired the Puritan Revolution, that dramatic interruption of the Stuart line, and from the same spirit arose the long and tragic struggle for freedom in the Netherlands.

Lutheranism on the other hand proved hospitable to a union between Church and State; but in the Germanic lands in modern times it has produced a merely nominal religious conformity. During the last 100 years some of the most undesirable effects of the state-church system have become visible in Germany,—secularism, formalism and the inevitable detachment of morality from the controlling sanctions of a vital religious faith. Within the United States Lutheranism has suffered from sectarian movements not unlike those which have divided and subdivided other Protestant churches. In spite of the traditional boast that Lutherans know no sects, there are more different Lutheran organizations in the United States to-day than there are of any other Protestant denomination. Western and northern Germany and German Switzerland became almost wholly Protestant in the 16th century. The Reformed faith also made important gains in France, showing an especially vigorous growth so long as the Edict of Nantes continued in force (1598–1685). With the revocation of that edict a Roman Catholic reaction set in and the gains which Protestantism had made were mostly wiped out. Denmark and Sweden early received the Lutheran Reformation and have remained Lutheran down to modern times. The Calvinistic faith was the controlling one in French Switzerland, the Netherlands, the British Islands and New England. Protestant liberalism in the form of Socinianism early found a home in Poland and Transylvania. The European lands least affected by the Reformation were Italy, Austria, Spain and the countries where the Eastern Church held sway.

Protestants of all types were agreed in their opposition to Roman Catholicism, however energetically they might differ among themselves. This opposition took form at first in the rejection of the Papacy (q.v.). It next showed itself in the rejection of the Roman hierarchy and the sacramental system. The popular demand for a reformation of notorious abuses, such as simony, nepotism, pluralities, laxity of discipline, clerical ignorance, etc.,— a demand which had long been heard on all sides, and which had been ably advocated by Erasmus and other humanists,— materially strengthened the forces which made for ecclesiastical revolution, and prepared men's minds for the adoption of more radical measures than were at first contemplated by the leaders of reform. Not all Protestants, however, rejected the theory of church government by bishops, and the history of Protestantism shows a sharp distinction between the churches which have retained the episcopate and those which have rejected it. The best-known examples of the churches maintaining an episcopal type of government are the Church of England, the Protestant Episcopal Church, and the Methodist Episcopal Church of the United States.

The Anglican Church, so far as it may be regarded as detached from the Catholic Church of the West, owes its origin to a movement in the reign of King Henry VIII whereby the papal jurisdiction in England was abolished. For a time the English Church endeavored to maintain its doctrine and canon law in other respects unchanged. But Puritanism, which is only thorough-going Protestantism, soon grew up within the Church of England, and the long struggle of the 17th century, which in 1689 resulted in the toleration of Non-Conformity, left the English people religiously divided and created an ecclesiastical situation which, with some modifications, has ever since continued. Thenceforward there were in the kingdom (1) the Established Church, Episcopal but not Roman Catholic; (2) the Non-Conformist bodies, which for some time labored under various political disabilities which have since been removed; and (3) the Roman Catholics, who down to the period of Parliamentary reform and Catholic emancipation (about 1830) were also under serious political disabilities. It was partly in indirect consequence of the Oxford movement, and because of the going over of a considerable number of Anglicans to the Roman obedience, that Roman Catholicism in England received a considerable increase of strength and now includes in its membership an important fraction of the population. The Established Church at present comprises only about one-half of the English people.

Denominationalism found its special field of action and reached its highest development within the territory of what is now the United States. The earliest discoveries and conquests in North America were indeed made by Roman Catholic nations, especially by the Spaniards. At a somewhat later date the French, also Roman Catholics, explored and attempted to colonize the valley of the Saint Lawrence and region of the Great Lakes. The settlements however which proved most enduring and which gave permanent character to the political institutions of the new world were those of English origin. The two groups of English colonists, Anglican in Virginia, Puritan and Separatist in New England, proved not to be sufficiently unlike to render difficult a political union, which came about at the American Revolution. The existence of several varieties of Protestant churches, as well as the abstract political theories held by the framers of the Federal Constitution, made possible the adoption of the American system of a free church in a free state. The Constitution, including its first amendment, prohibits the establishment of religion, and all interference with the free exercise thereof. As a consequence denominationalism in the United States has had a free opportunity for development, with the obvious disadvantage of a rapid increase in the number of sects, but with the compensating advantage of an unmatched opportunity for judicious comparison of their value and for the survival of the fittest.

Among the leading Protestant denominational types represented in the United States are the Congregational and Baptist (which are very similar in polity), the Presbyterian, the Episcopalian, the Methodist and the Lutheran. Of most of these there are several distinct or subordinate varieties. Outside the leading groups lie many ecclesiastical organizations, some of them with a large constituency, each of which exhibits some special feature of doctrine or polity upon which its denominational existence is based. During recent years a movement toward affiliation and union has gained increasing strength among many Protestant bodies, and this movement is likely to be accentuated by centralizing influences growing out of the Great War.

The distinctive characteristics of Protestantism continue to be those which the great reformers more or less perfectly perceived, but which they did not always follow to their consistent and logical conclusion. The two great Reformation principles were justification by faith alone through divine grace, and the sole authority of Scripture in matters of faith. Involved in these was another principle, perhaps more comprehensive than either of them, namely, the inalienable right of private judgment in religion. The history of Protestantism exhibits the gradual working out into full recognition and acceptance of these fundamental principles. But the process is still incomplete. It is obvious that many nominal Protestants have not as yet fully accepted these principles, yet modern Protestantism has recently begun to recognize more fully their true significance. Catholicism on the other hand, whether Greek, Roman or Anglican, is frankly based upon the principle of a divinely authoritative church, organized and governed according to apostolic precept, exhibiting a legitimate succession of bishops outside of which there is no authorized ministry, maintaining unimpaired an original deposit of faith, and thus furnishing a living organ for the exercise of divine authority throughout all the generations. For the existence of such a divinely authoritative church it is immaterial whether the authority be exercised by a Pope or by a council of bishops; the principle remains the same.

The Protestant conception of the Christian ministry is very different from that outlined above. In spite of exceptions and inconsistencies the logic of Protestantism requires that the Christian minister shall be essentially the pastor and teacher of his people, chosen by them to lead in public worship and to administer the sacraments, and that his position shall be representative, not sacerdotal. Strictly speaking there can be no such thing as a Protestant hierarchy. Nevertheless it must be freely recognized that in many Protestant churches a conception of the ministry still obtains very different from this — a conception which really involves the persistence of Catholic theories within the boundaries of nominal Protestantism.

The distinction between the two types of religion here contrasted has been stated thus: Catholicism furnishes to the individual believer an institutional guarantee of salvation; Protestantism insists upon personal assurance of salvation. Looking at the question from a slightly different angle, Schleiermacher said that Catholicism makes the relation of the believer to Christ depend upon his relation to the Church, while Protestantism makes the relation of the believer to the Church depend upon his relation to Christ. It is obvious that between these two conceptions of religion there is a fundamental difference.

Present-day Protestantism comprehends practically all of those who have dissociated themselves from the Catholic Church in any of its forms. It will, therefore, include many persons who are not actively identified with any Church, but who would refuse to be classified as Catholic. In the Protestant Churches there are wide divergencies of opinion upon theological matters and the constant tendency of Protestantism is away from dogmatic theology and toward the employment of simple religious formulas and the promotion of practical religious and philanthropic activities. Dogmatism still lingers here and there in Protestant communities which are intellectually less progressive, but it no longer plays an important part in the more enlightened section of Great Britain and America. Protestant creeds and confessions of faith tend constantly to grow more simple and general in their language, and look toward a definition of Christian duty in practical life rather than toward the formulation of a speculative theological system.

Protestant worship is characterized by simplicity and directness, especially in comparison with the stately ritual of the Mediæval Church. Catholicism makes the altar central, and emphasizes the sacrificial aspect of Christian worship; Protestantism substitutes the pulpit, and thus shows its predominant characteristic to be that of a teaching church. The idea of mystery in worship gives place to intelligibility. In the early days of Protestantism this simplicity became at times barrenness, for example among the Puritans. But in modern times there has come a reaction against this tendency, and the forms of public worship have grown more elaborate, resulting often in the adoption of a liturgy not unlike the services of morning and evening prayer in the Church of England.

A great variety of philanthropic activities have been created by Protestants during the past 100 years. Missionary enterprises, both domestic and foreign, educational institutions of every grade, hospitals and other remedial agencies for mind and body, organizations for social betterment, young men's and women's Christian associations, and many related undertakings, here have their origin. Similar institutions also exist among the Roman Catholics, and in not a few instances Catholics and Protestants now fraternally co-operate, to the obvious advantage of both. Many educational institutions within the United States, which owe their origin to a distinctively religious motive, have lately become unsectarian and to the ordinary observer practically secular. This secularizing tendency, traceable in the history of Protestant education, finds little counterpart among the schools and colleges which are under the control of the Roman Catholic Church.

Reliable religious statistics for some countries are hard to obtain, but the following table exhibits with a fair degree of accuracy the numerical strength of the various ecclesiastical groups throughout the world at the beginning of the 20th century:

Roman Catholics, about 250,000,000.
Greek Catholics, about 125,000,000.
Protestants (including Anglicans), about 175,000,000.

The approximate membership of the principal churches within the United States at the present time may be estimated as follows:

Roman Catholics, about	16,000,000
Methodists, about	7,800,000
Baptists, about	6,500,000
Lutherans, about	2,500,000
Presbyterians (including Reformed), about	3,300,000
Disciples, about	1,400,000
Episcopalians, about	1,100,000
Congregationalists, about	800,000
United Brethren, about	350,000

The Protestant groups here listed include in several instances churches which have separate organizations but which are sufficiently alike in doctrine and polity to be included under the same general designation. Some of the smaller churches are omitted entirely, except in the summaries given below. The membership of the Roman Catholic Church and of the Protestant Churches within the United States may be thus summarized:

Roman Catholics, about	16,000,000
Protestants, about	24,000,000

The actual constituency of both is of course much larger than the figures given above, which include only those who are in full membership.

Ever since the period of the Reformation, and until comparatively recent times, church historians have endeavored to show either that Protestantism was an unjustifiable departure from the principles and usages of the Church for more than a thousand years (the Catholic position), or that Protestantism finds its justification in primitive Christianity, that the Mediæval Church had grown increasingly corrupt with the lapse of time, and that the reformers' effort to do away with its corruptions and to return to the simplicity of the New Testament was not only legitimate but was also their obvious Christian duty. The latter is the Protestant position. These two tendencies find their best early illustration on the Protestant side in the 'Magdeburg Centuries,' and on the Roman Catholic side in the 'Annals' of Baronius. It was only in the 19th century that the period of critical ecclesiastical historiography began. At the present day writers of all schools exhibit an increasing desire for the impartial treatment of church history, and many of them employ a critical method which is making their subject a true science.

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PROTEUS, prō'tūs, or prō'tē-ŭs, in Greek mythology, according to Homer (whose account is the one chiefly identified with the name "the old man of the sea"), a subject of Poseidon (the sea god), gifted with the power of prophecy, who pastured the seal herds of Amphitrite upon the shore of the island of Pharos near the mouth of the Nile. According to Virgil his abode is located on the island of Carpathos, between Crete and Rhodes. ('Georgics' IV, 386). He is represented as of great age and able to change himself instantly into any form he might wish. To compel him to prophesy it was necessary to steal craftily upon him and hold him so that he might not escape whatever form he took. Menelaus, as told in the Odyssey (IV, 351), succeeded in doing this even though Proteus became in turn fire and water. Allusions to Proteus refer to his power of assuming many forms, as in the adjective, protean. Herodotus (II, 112, 118) relates that Proteus as king of Egypt entertained Paris and Helen, but giving Paris a phantom in her stead kept Helen with him and afterward restored her to her husband, Menelaus. Consult Preller, L., 'Griechische Mythologie' (2 vols., Berlin 1872–75); Weissaecker, P., 'Proteus' (in Roscher, W. H., ed., 'Ausführliches Leikon der Griechischen und Römischen Mythologie,' Vol. III, pt. 2, p. 3172, Leipzig 1902–09); Welcker, F. G., 'Griechische Götterlehre' (3 vols., Göttingen 1857–63).

PROTEUS, a remarkable genus of urodele amphibians allied to the axolotls, sirens, etc., and often called "mud-puppies." The gills in these are retained throughout the entire lifetime of the animals, in addition to the lungs with which they are also latterly provided. These animals are found only in the waters of certain subterranean caves in central and southern Europe. The animal itself is about 12 inches long. Its body is elongated, slender and somewhat cylindrical, and averages about one inch or three-quarters of an inch in diameter. It is of a pale flesh tint — the absence of color being the necessary result of its non-exposure to light. The tail is broad and compressed. The limbs are weak, the front legs possessing three and the hinder limbs only two toes. Three pairs of bright red or scarlet branchiæ or gills project from the branchial clefts on each side of the neck. Two series of small teeth exist in the upper and in the lower jaw. The eyes are rudimentary and completely covered by the skin. The proteus is eminently aquatic in its habits, and in dry seasons, or when the water of the caves becomes dried up, is said to bury itself in the mud. See Proteidæ.

PROTEUS ANIMALCULE. See Amœba.

PROTEVANGELIUM, prō-tē-văn-jĕl'ĭ-ŭm (Greek "the first gospel"), term applied to the passage in the Old Testament, Genesis iii, 15, in which theologians see the first announcement of the coming of a Messiah. It is also applied to an apocryphal gospel, ascribed by some to Saint James the Less.

PROTHERO, prŏth'ĕr-ō, **George Walter**, English historical writer: b. Wiltshire, 14 Oct. 1848. He was educated at Eton, Cambridge and the University of Bonn, was university lecturer in history and tutor of Kings College 1876–94, and professor of history at the University of Edinburgh 1894–99. He is a member of the Royal Historical Society, the president of which he was 1901–05. He is also a member of a number of other historical societies in England and other countries, an Honorary Fellow of King's College, Cambridge, holds honorary degrees from Cambridge, Edinburgh and Harvard and is editor of the *Quarterly Review*. In 1910 he was Lowell lecturer at Boston and Schouler lecturer at Johns Hopkins, Baltimore. Together with A. W. Ward and S. Leathes he has edited 'Cambridge Modern History' (14 vols., Cambridge 1901–12) to the fourth volume of which he contributed four chapters on English history, from 1625–49. He has also edited the 'Cambridge Historical Series,' some early volumes of the 'Pitt Press Series,' L. V. Runk's 'Universal History' (New York 1885), and J. R. Seeley's 'The Growth of British Policy' (2 vols., Cambridge 1895). He is the author of 'The Life of Simon de Montfort' (London 1877); 'A Memoir of Henry Bradshaw' (London 1889); 'Select Statutes and Other Constitutional Documents Illustrative of the Reigns of Elizabeth and James I' (Oxford 1894); 'British History Reader' (2 vols., London 1898); 'School History of Great Britain and Ireland to 1910' (London 1912); 'German Opinions and German Policy before the War' (London 1916); 'A Lasting Peace' (London 1917); and with A. J. Philip, 'Catalogue of War Publications to June 1916' (London 1917).

PROTHERO, Rowland Edmund, English author, brother of G. W. Prothero (q.v.): b. Clifton-on-Teme, 6 Sept. 1852. He was educated at Marlborough and Oxford and was editor of *The Quarterly Review* 1894–99. From 1875–91 he was a Fellow of All Souls College, Oxford. Since 1914 he is M.P. for Oxford and since 1916 president of Board of Agriculture. He is the author of 'Pioneers and Progress of English Farming' (London 1887); 'Life and Correspondence of Dean Stanley' (2 vols., New York 1893); 'The Psalms in Human Life' (London 1903); 'The Pleasant Land of France' (London 1908); 'English Farming Past and Present' (London 1912); and has edited 'Letters and Verses of Stanley' (London 1895); 'Private Letters of Edward Gibbon' (2 vols., London 1896); 'Handbook for Travellers in the Isle of Wight' (London 1898); 'Letters and Journals of Lord Byron' (6 vols., London 1901–04); 'Letters of Richard Ford' (New York 1905).

PROTHONOTARY, also **PROTONOTARY,** in Pennsylvania, and a few other States, the name given the judge of the Orphans' Court. (See COURT). Formerly the term was applied to chief clerks or registrars in most English courts of law. It is still applied, usually in the form "Prothonotary Apostolic" to certain functionaries connected with the papal court who receive the last wills of cardinals, make informations and proceedings necessary for the canonization of saints, etc.

PROTISTA, a group-name introduced by Ernst Haeckel to designate the simple forms of life appearing spontaneously in infusions of animal and vegetable matter, and known as the organisms of fermentation and putrefaction. They have all been proved to arise from preexisting germs. The group includes both the protozoans and the unicellular plants.

PROTOAMŒBA. See MONER.

PROTOCOL, *in diplomacy,* the minutes of the discussions of a conference, or the tentative draft of an instrument or transaction; a statement of the principles to be afterward embodied in a treaty or the original copy of such treaty, dispatch or other document; a document serving as the preliminary to diplomatic negotiations; a diplomatic document or minute of proceedings, signed by the representatives of friendly powers in order to secure certain political ends peacefully; a convention not requiring the formalities of ratification. By a *protocol* concluded and signed 12 Aug. 1898, by William R. Day, Secretary of State of the United States, and Jules Cambon, Ambassador Extraordinary and Plenipotentiary of the republic of France, at Washington, respectively representing for that purpose the government of the United States and the government of Spain, the United States and Spain agreed upon the terms on which negotiations for the establishment of peace between the two countries should be undertaken. Following the signing of this peace protocol, President McKinley issued a proclamation suspending hostilities.

PROTOCOL, The Industrial, a juridical covenant formed in 1910 between the several associations of New York manufacturers, respectively, of dresses and waists; of children's dresses; of ladies' underwear; of embroideries, and of house dresses and kimonos, and the 60,000 operatives employed by these industries. The agreement was brought about by the endless conflict between the manufacturers and the workers, resulting in a series of strikes and lockouts in which both sides were losers. The condition arose from the very large number of small individual manufacturers, who, in the necessities of keen competition, pursued widely diverse shop methods, some to the benefit but more to the detriment of the employees. Friends of the workers joined with them in an endeavor to stabilize working conditions and wage incomes, and the protocol resulted. The instrument established certain foundational rights and principles on behalf of the workers, and provided that these should be forced upon the less scrupulous individual manufacturers by the large associations who joined in the signing of the protocol. The manufacturers were assured that there should be no strike; that work should continue, no matter what the dispute, and that the differences should be referred to a board of arbitration, of which Justice Brandeis was the first chairman, succeeded upon his elevation to the Supreme Court by Justice Mack. A board of standards of nine members was created, with three representatives of the manufacturers, three of the employees and three persons representing the public. Its office was to enforce the provisional standards set forth in the protocol and adjust from time to time the conditions of pay to the market values of the work produced. The instrument provided for "fair and reasonable" betterments from time to time, both in working conditions and wages. This was the seed of disruption, the workers claiming that these betterments did not materialize as rapidly as they should, and an open break occurred in 1915. The mayor's

"Council of Conciliation," headed by Dr. Felix Adler as chairman, was successful in readjusting the difficulty, and the protocol was revived. It was again terminated in 1916, this time by the manufacturers, who claimed that the dictation of the union officials was ruinous to their business. The workers contended that the conduct of the business on the part of the manufacturers was so incompetent that they were shut out from the betterments which they had a right to expect. Since 1916 there has been much disturbance, and several strikes have occurred in spite of the provision of the protocol that work shall continue. The workers have gained substantial increases in wages and the 44-hour week. The protocol still remains as a psuedo-covenant, though hardly with its former prestige, both workers and manufacturers having lost faith in it.

The idea is regarded favorably by social workers and has been adopted in Chicago, Philadelphia and Boston.

PROTOGENES, prō-tŏj'ĕ-nēz, Greek painter, contemporary with Apelles: b. Caunus on the coast of Caria. He lived about 350 B.C. and spent most of his life in Rhodes. He was one of the first of Greek realists in painting. Several masterpieces of his are mentioned, in one of which a Rhodesian local hero, Ialysus, was represented hunting with a panting hound which showed foam on his mouth. Pliny, who is our chief source of information ('Hist. Nat.,' XXXV, 36), relates that for a long time the painter failed in the execution of the foam; but at last, in a fit of anger, threw against the picture the sponge which he used in painting, and thus accidentally produced a natural representation of it. This picture saved the city of Rhodes when it was besieged by Demetrius Poliorcetes (305–304 B.C.) who refrained from making his attack on the weakest part of the city where the picture was placed. In the time of Cicero it was in that city, but Vespasian carried it to Rome, and placed it in the temple of Peace, in which it was burned under Commodus. Protogenes is said to have lived in comparative obscurity at Rhodes till the 50th year of his age, when his merits were made known to his fellow-citizens through a visit of Apelles (q.v.). Apelles offered Protogenes an enormous sum for each of his works, which the painter himself had been in the habit of selling for very insignificant sums. The Rhodians now wished to buy back the pictures from Apelles, in order that they might keep them among themselves, but Apelles refused to part with them except for an advance. Protogenes subsequently went to Athens, where he executed the 'Nausicaa,' one of his finest pictures in the Propylæa. Amongst other famous pictures ascribed to Protogenes should be mentioned 'Satyr playing on a Flageolet'; 'Cydippe'; 'Tlepolemus'; 'Alexander and Pan'; portraits of Philiscus, Antigonus and Aristotle's mother. He is also reported to have executed a number of statues in bronze, especially of athletes, soldiers and hunters. Consult Bostock, J., and Riley, H. T., 'The Natural History of Pliny' (Vol. VI, London 1857); Brunn, H., 'Geschichte der Griechischen Künster' (2 vols., Stuttgart 1857–59); Hauler, E., 'Fronto über Protogenes und Nealkes' (in *Kais.-Deutsches Archäologisches Institut, Mitteilungen, Römische Abteilung*, Vol. XIX, p. 317, Rome 1904); Hwiid, A. C., 'Protogenes' (Copenhagen 1788); Maas, E., 'Apelles und Protogenes' (in *Oesterreichisches Archäologisches Institut in Wien, Jahreschefte*, Vol. XI, p. 29, Vienna 1908); Six, J., 'Protogenes' (in *Kais.-Deutsches Archäologisches Institut, Jahrbuch*, Vol. XVIII, p. 34, Berlin 1903); Winckelmann, J. J., 'History of Ancient Art Among the Greeks' (trans. by G. H. Lodge, new ed., 4 vols. in 2, Boston 1880).

PROTOGYNY. See POLLINATION.

PROTOHIPPUS, or **PROTOROHIPPUS**, genera of early fossil ancestors of the horse. See HORSE, EVOLUTION OF.

PROTOPHYTES. See FUNGI.

PROTOPLASM. The most fundamental characteristic of animals and plants is life. While no one can, as yet, demonstrate just what the physical basis of life is, still there is general agreement that the substance known under the rather indefinite name of *protoplasm* is that physical basis. The term was first used in 1840 by Purkinje, who applied it to the whole substance of young embryos, so that it included cell walls as well as cell contents. Von Mohl, in 1844, restricted the term to the living contents of the cell. At present, it is still further restricted, being applied to the living contents of the cell, exclusive of the nucleus, so that the living contents are said to consist of nucleus and protoplasm. In this latter sense, some use the term cytoplasm, instead of protoplasm. Protoplasm is, typically, a viscid substance, usually colorless, and it will not mix with water. In some forms and under some conditions, it has more tenacity and in the resting, but still living condition, found in seeds, it may become as hard as bone. Between the soft, viscid condition and the bony condition found in seeds like the date and vegetable ivory, there is every conceivable gradation. Chemically, protoplasm consists principally of carbon, hydrogen, nitrogen, sulphur and oxygen, but may contain also smaller quantities of chlorine, phosphorus, potassium, sodium, magnesium, calcium and iron. Living protoplasm is alkaline, turning the red litmus blue. In regard to the structure, there is great diversity of opinion, but most investigators believe that it is something like foam or honeycomb. There is a round substance containing globular bodies of various sizes, so that protoplasm looks like an emulsion, and its general appearance may be simulated by mixing olive oil and common salt. In active living cells, the protoplasm is always in motion and in some cases the motion is so rapid that it can be seen even under a low power of the microscope. In the long cells of the stonewort, *Chara*, the protoplasm moves round and round in a definite path. In the stamen hairs of the Spider Lily (*Tradescantia*), the movement is easily observed. Stinging hairs of various plants will generally show some movement and any very thin leaves of water plants are good subjects. The outer layer of the protoplasm is somewhat different from the rest and has been called the plasmamembrane (the *Hautschicht* of the Germans). It is sometimes visible and sometimes not, but it is claimed that it is always present. The protoplasm of adjacent cells is connected by extremely fine threads, called proto-plasmic connections, which bind the living parts of the plant into a more or less connected whole. These threads pass through almost inconceivably small pores in the cell walls. If the threads are unusually small, they can be demonstrated by using reagents which cause swelling, and then applying dyes to the swollen structures. When plants die and the living contents of the cells dry up and seem to disappear entirely, as in the case of seasoned wood, the threads still remain in the pores and can be demonstrated. There is abundant room for all kinds of investigations upon protoplasm. Consult Butschli, O., 'Untersuchungen über mikroscopische Schäume und das Protoplasma'; Wilson, E. B., 'The Cell in Development and Inheritance.'

CHARLES J. CHAMBERLAIN.

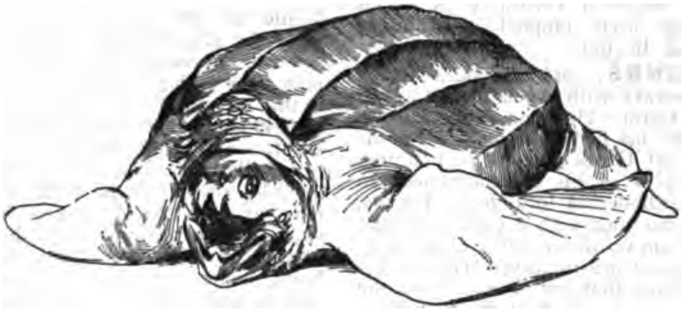


FIG. 1.— *Dermochelys coriacea.* Extreme weight about 1,500 pounds or half that of the *Archelon* shown in the plates. Carapace seven keeled, and made up entirely of an osteodermal mosaic invested in a leathery hide.

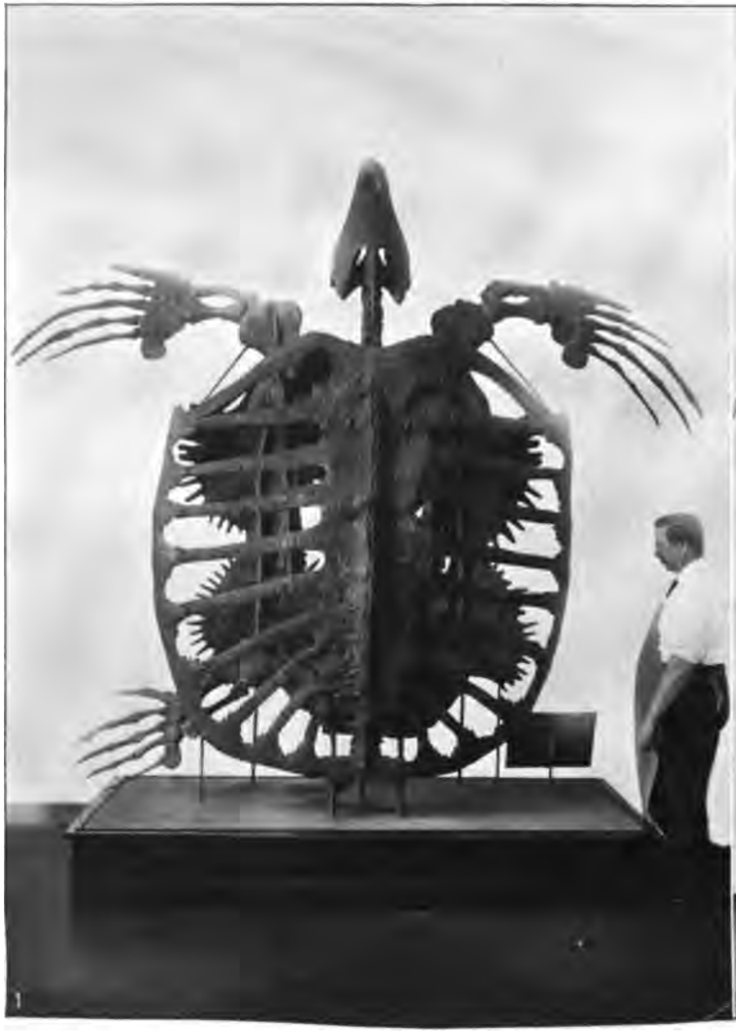
PROTOSTEGIDÆ, a family of mostly gigantic marine Testudinata, or "turtles," now wholly extinct, from the mid-Cretaceous Niobrara Chalk beds of western Kansas, and the overlying Fort Pierre formation of South Dakota. These turtles lived in the great but shallow supra-continental or "epeiric" Niobrara and Pierre seas. They were shell fish eaters, well able to navigate the open ocean and among the most formidable of marine reptiles. The group is of extreme osteologic interest.

The first specimens were discovered along the Smoky Hill River by Cope in 1871, and called by him *Protostega gigas*, being recognized as a new family type. The great Yale specimens of a second genus *Archelon* were secured by Wieland in 1895 to the east of the Black Hills along the Cheyenne River in the uppermost Pierre shales near the overlap of Bad Lands (Tertiary). Ten years later the veteran fossil hunter Charles H. Sternberg, to whom American paleontologists owe many unique "finds," again collected Protostegas along the Smoky Hill River which aided greatly in completing the details of the skull and limb organization. One of these, made the subject of a restoration in the Carnegie Museum at Pittsburgh, is truly remarkable, the flippers having nearly all their elements in place.

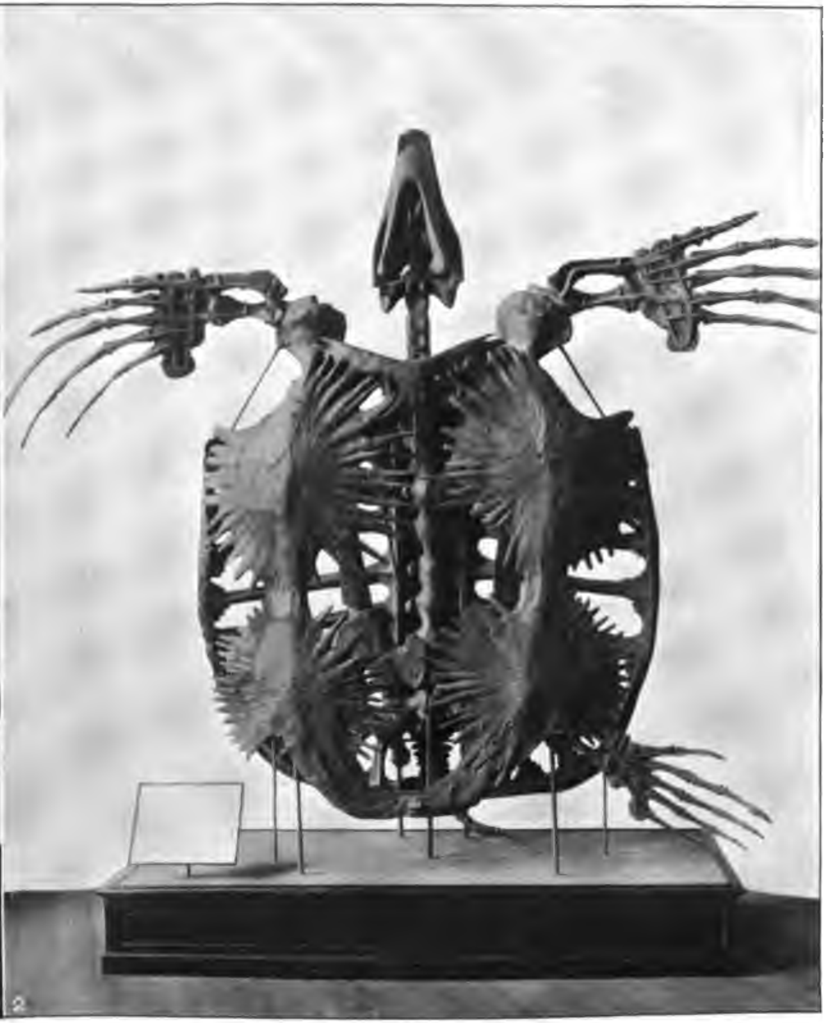
The Yale *Archelon* from the Cheyenne River is only less complete, but much larger and an even finer fossil. It represents a huge turtle nearly 12 feet long with front flippers of an indicated 15-foot span. (See Plates). As a unit of size, it may be mentioned that the humerus as fossilized, and mounted, weighs just 75 pounds. Another fragmentary specimen was still larger, and indicated a turtle 14 feet in length. The habitus being robust, this formidable boatman of the Cretaceous seas represents the culmination in size of not only the Protostegids, but the entire order. If the paleontologic record may be trusted, not until the comparatively recent Pliocene of the Siwalik Hills of Northern India do land species approach in size but scarcely rival the Cretaceous *Protostega* and *Archelon*. That, which renders the Protostegids conspicuously interesting is, however, not so much their size as their structure. It is this group which has gone far towards yielding a convincing solution to one of the most instructive but difficult of all problems presented by reptilians, the origin of Dermochelys, the "leatherback" of present day tropic seas.

It should be recalled that *Dermochelys* differs from all other turtles in the absence of a dorsal bony carapace of neurals, pleurals and marginals interlocked. This protecting roof is instead replaced by what may be termed a *pseudo-carapace* of innumerable interlocking polygonal plates, all osteodermal in character and marked by seven ridges or dorsal keels. (See Fig. 1). Under this shield the ribs are slightly expanded proximally but neither unite with each other or with neurals, which wholly fail; though oddly enough there is a large thin detached nuchal.

The osteodermal mosaic of plates also continues around on the nether or plastral side presenting five more of the keels. But here the plastron is found in the underlying normal, that is subdermal position, except for the further anomaly of a missing entoplastron. That this element should lack, while an unsupported nuchal persists is singular. The plastral bones, however, are slender and thin, enclosing a vast fontanel, and having every appearance of extensive reduction. Now, the sum of Dermochelan characters, despite certain cranial resemblances to other sea turtles and more remotely to Chelydra, might lead to the view that of all the Testudinata, *Dermochelys* is nearest to a primitive form with the ancient keels still present. But if evidence of osteodermal keels is found in fossil forms, and if additional skeletal resemblances are there recognizable, then *Dermochelys* is far more closely related to modern forms than at first appears to be the fact,— is in a word not the least, but the most specialized of turtles.



1 Archelon ischyros Wieland. Dorsal view of the Cheyenne River specimen mounted at Yale. The right hind paddle was early in life bitten off by some predaceous enemy, as a fish, shark or mosasaur, of the Pierre sea



2 Archelon ischyros Wieland. Plastral view of the Yale Cheyenne River specimen. See Plate 1. Length 11 feet

The latter alternative appears nearest the truth. *Protostega Copei* of the Niobrara has a shell as heavy as that of marine species in general, but there is some plastral reduction with digitation of the separate elements. In the contemporaneous *Protostega gigas* rib and plastral reduction are seen to have gone still further; while in *Archelon* of the considerably later Pierre, carapacial reduction has proceeded very far. The ribs (see Plate) only show a small thin proximal expansion, while the neurals are nearly eliminated and ridden by a median keel of elements as truly osteodermal as those of the Dermochelan carapace. There are moreover highly digitate marginals, with pretty clear evidence of a supramarginals row. Bearing in mind that the marginals of all Testudinates are dermal, this accounts for the chief of the Dermochelan keels. With (1) segmentation of larger into lesser interlocking dermal or epithecal elements; (2) gradual thickening of these into a heavier shell; (3) a correspondent elimination of rib expansion and neurals; and (4) marked plastral reduction, the chief features of *Dermochelys* would be evolved in the late Cretaceous and Tertiary; though the actual line of descent might be a discrete one far back in geologic time.

neurocostal shield plus dermal marginals (see Fig. 3); (3) The Protostegids (and *Toxochelys*) have the most complex bithecal carapace known, retaining the subdermal elements with not only the marginals but supramarginals and a median keel of expanded epineurals; (4) *Dermochelys* in contrast with *Trionyx* has an osteodermal (mosaic) carapace, plus only the subdermal nuchal; (5) The Testudinate plastron is far less variant than the carapace. It remains complex in recent form only in *Dermochelys,* with both subdermal and dermal elements.

Taking both carapace and plastron, *Dermochelys* and the Protostegids are thus closely apposed, and other forms variant. But as indicated by large nutrition canals of the epineural keel, *Archelon* had a heavy leathery hide instead of an outer hornshield. It is, therefore, possible and probable that there were also dermal elements in the plastron. In this case the Protostegids were completely bithecal and fall still closer to the «leatherback» than is inferred from the resemblances cited.

The deeply interesting paleontologic problem here briefly outlined, is in a measure solved. But many details and doubts yet remain which only discovery of further evidence can resolve.

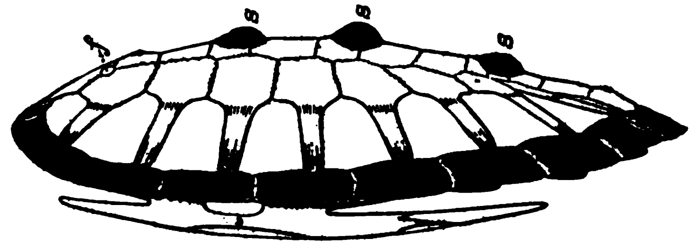


FIG. 2.—*Toxochelys Bauri* Wieland. (From the Niobrara Cretaceous of Kansas). Side view of carapace of diplogene type. The dermal elements (epineurals *S*, *S*, and marginals) are in solid black, and the subdermal elements (neurals and pleurals) in light outline. The hide being leathery, several rows of dermal elements must have intervened between the epineurals and marginals, thus fulfilling the old Prochelonian condition. See Fig. 3.

It is then virtually proved that in the primitive carapace there are two overlapping bony layers — the neurals and pleurals (costals) underneath, with a neural, pleural, supramarginal and marginal keel above. In the great majority of turtles the underlying neuropleural layer early interlocked with the marginal dermal keel, and all traces of the other dermal keels were gradually lost, or the hornshields were formed instead. But the *Protostegas* with the related form *Toxochelys* (see Fig. 2) indicates that an epithecum of median and lateral rows of dermal elements could also reach prominence, finally replacing the endothecum as in *Dermochelys.* The latter could not always have had so prominent an osteodermal mosaic as now, and it is difficult to believe that weak and thin neurals like those of *Archelon* were not once present in sequence with the nuchal. It is also significant that the nuchal, the pelvis and the epiplastron of *Archelon* strongly resemble these several elements in *Dermochelys.*

In recapitulation it is seen that: (1) The *Trionyx* carapace is now completely endothecal or subdermal; (2) in the majority of Cryptodiran and Pleurodiran Testudinates the carapace is diplogene,— that is, equals the subdermal

The general biologic problem has been outlined for just 50 years and naturalists who have successively given their attention to it are E. D. Cope, L. Dollo, G. Baur, O. P. Hay and G. R. Wieland; while especially J. Versluys and his students have considered the osteological evidence.

As a corollary the features of Dinosaurian armor are also brought into unity. In the Dinosauria as in the Testudinata there are the two armor forming strata. But while in the Testudines, *Miolania* affords the sole example of cranial armature, this occurs frequently in Dinosaurs and becomes extraordinary in the Ceratopsids, in which both the nether and upper layers take part in armor formation. Conversely in *Polacanthus* the deep layer forms a lumbar hip carapace. In the Stegosaurs the simple dermal armor takes the most singular expression seen in reptilians existent or extinct. Wieland, who was the first to point out this significant parallelism says:

«At first sight all development of dermal armor may appear to be mainly a senile feature due even to inertia — the general life movement of the individual and the race. But it is also evident that the development of dermal ossicles in series resulting finally in a protective sub, and osteodermal armature or carapace is a profound change co-ordinated with striking endoskeletal alteration. The Dinosauria developed their varied armor types late and when already highly specialized, apparently with only varying or far less success than the Testudinates. In them an early development of simpler patterns appears to have resulted in an exceedingly long lease of life.»

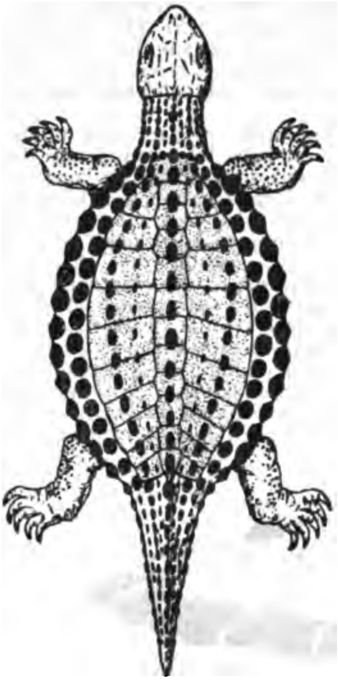


Fig. 3.— Hypothetical protochelonian. As in Fig. 2, the dermal elements are in solid black, and the subdermal or neuropleural shield in light outline.

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PROTOTHERIA, a division or subclass of mammals embracing the *Monotremata* (q.v.) and with more or less certainty some fossil forms classified as *Protodonta* and *Allotheria* or *Multituberculata*. In the living forms their most marked peculiarities are that though classed as mammals they are without teats, that they are oviparous or ovoviviparous, and that they have but a single opening for the digestive tract and the urogenital system; a feature which also obtains in the marsupials, beavers and some other rodents. The sutures of the skull are obliterated, and while in the young there are peculiar teeth with many tubercles upon the crown, these are lost in the adult, the jaws being furnished with horny plates. Similarities in the teeth lead the fossil forms to be associated here. The only living examples are the duck-billed platypus (*Ornithorhyncus*) and spiny ant-eaters (*Echidna*). The marsupials are sometimes known as *Metatheria*, and all other mammals as *Eutheria*; but the latter term is more scientifically made to include all mammals except the monotremes. Consult Beddard, F. E., 'Mammalia' (Cambridge 1902).

PROTOZOA. Fundamentally contrasted with all other types of animal life, which are together designated the Metazoa, in that the body consists of a single cell or a colony of simple cells, the group is still usually termed a phylum though it is evidently of a higher grade than the subdivisions of the Metazoa to which that rank is always assigned and the designation sub-kingdom seems better justified. The organisms included are all minute; the largest being barely visible to the naked eye and the smallest lying at or beyond the limits of optical vision. With great simplicity of structure they combine functional complexity equal in a general way to that in the Metazoa. Although for the most part the group is well defined yet there exist forms that constitute an unbroken series from such as manifest clearly animal characteristics to those which are equally certainly plants. Transitional forms that bridge the gap between Protozoa and Metazoa are also well known; these are colonial types in which a differentiation between certain cells marks the first step in the production of the Metazoan organism. While structurally simple the Protozoa have many specialized parts, the cell-organs or organellae, for the discharge of particular functions. Thus for locomotion one finds projections of the external layer, either in the form of soft, mobile protoplasmic lobes that undergo constant changes in form, the pseudopodia, or in fixed processes of contractile substance known as flagella and cilia that carry out vibrating movements which propel the body and aid in taking food. The simplest types consist, like the Amœba, of a mere drop of naked protoplasm enclosing a nucleus. In most forms, however, a cell-membrane covers the mass and imposes evident limits on its activity, though it is on the whole an advance in specialization.

Many forms possess protective coverings like shells, scales and spines that are permanent, or cysts which are of a temporary character and related to special conditions such as reproduction, drought and seasonal changes. Membraneless forms ingest food at any point but those species with a membrane have at least a mouth opening and sometimes a second orifice for the extrusion of solid waste. The membrane may form at the mouth an inturned funnel-shaped esophagus. Many parasitic species have an unbroken membrane and take nourishment by osmosis. Contractile vacuoles fed by delicate radiating canals serve to eliminate waste and excess of water from the protoplasm, thus serving both as respiratory and as excretory organs. The existence of anuclear forms, the Monera of Hæckel, is now strongly doubted. On the other hand the normal mononuclear condition is varied by a binuclear type in some groups. One also finds a multinuclear condition which may indicate a colonial organism or a phase in reproduction just antecedent to spore formation. Division is the ordinary method of reproduction and may be simple or multiple either in the free or the encysted state. Similar spores (*isogametes*) or dissimilar spores (*micro-* and *macro-gametes*) are produced by most Protozoa, and may develop asexually, but in many cases fuse by pairs as a preliminary phase in the life cycle that suggests the start of Metazoan development.

Many parasitic species exhibit the alternation of two different generations, or a change of hosts as a characteristic factor in their life history. Parasitic Protozoa may infect an organ or an individual cell, or even be found in a nucleus; and the various phases in the life cycle may illustrate these different locations as the malarial plasmodium is successively a cell parasite in the red corpuscle, an organ parasite in the blood, and a tissue parasite in the wall of the mosquito's midgut. No less distinctly than in Metazoa are the effects of parasitism seen among Protozoa as in the degeneration of structures characteristic of free life, in the formation of hold-fast organs, in the increase of reproductive activity, in the occurrence of metagenesis, and in the adjustment of the parasitic life cycle to the habits of the host. Protozoan parasites are the cause of serious and even fatal diseases when by tissue destruction they produce ulcers or by tissue proliferation they give rise to tumors. Metabolic products resulting from the activity of the invading Protozoa may exert a powerful toxemic influence on the host as is well recognized in malaria for instance. The source of human Protozoal diseases may be found in the ingestion of encysted spores with impure food or drink, or it may be traced to the active inoculation of such spores through the medium of some blood sucking insect, like the mosquito, bedbug or louse. The control of Protozoal diseases depends clearly upon knowledge of the life cycle of the organism and of its means of transmission. The brilliant successes of recent years in controlling malaria, yellow fever and other Protozoal diseases depended absolutely on attacking the parasite at some weak point in its life cycle and by preventing its dissemination putting an end to the disease. In this great work American investigators have played an important rôle. The most important Protozoal diseases of man are amœbic dysentery due to several species of Entamœba; sleeping sickness of tropical Africa caused by Trypanosoma, a flagellate blood parasite; malaria, a scourge of tropical and subtropical regions since history began, produced by Plasmodium. In yellow-fever the organism is yet undiscovered but apparently belongs in the Protozoa; and in typhus it is a minute spirillar structure sometimes placed here and sometimes included under the Protophyta. To other less important human diseases must be added many formidable pests to which domestic animals are subject and a host of others that attack all sorts of animals. These facts serve to show the great and growing importance of Protozoa in an economic way. Among the Protozoa are distinguished the following major sub-divisions, termed classes or less often phyla: (1) Sarcodina, naked forms moving by pseudopodia; (2) Mastigophora, usually with a membrane and with flagella for locomotion; (3) Sporozoa, exclusively parasitic, without locomotor processes of any sort. Spores without polar capsule; (4) Cnidosporidia, exclusively parasitic, sometimes amœboid. Spores with one or more polar capsules; (5) Infusoria, with firm membrane, moved by cilia. Among groups *incertae sedis* are the Spirochætidæ, often included near the Mastigophora, and the Chlamydozoa, possibly related to the Sarcodina; the first contains the organism of syphilis, the second those of some obscure diseases, but the exact place of both is at the present date very doubtful. Consult Calkins, G. N., 'Protozoa' (New York 1901); Lankester, E. R., 'A Treatise on Zoology' (London 1903); Hartog, M. M., 'Protozoa' (in 'Cambridge Natural History,' Vol. I, New York 1909); Minchin, E. A., 'Introduction to the Study of the Protozoa' (New York 1912).

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PROTRACTOR, an instrument for laying down and measuring angles on paper, and by which the use of the line of chords is superseded. It is of various forms — semicircular, rectangular or circular.

PROUD, Robert, American historian: b. near Yarm, Yorkshire, 10 May 1728; d. Philadelphia, Pa., 7 July 1813. He came to America in 1759 and settled in Pennsylvania where he engaged as teacher of Latin and Greek in a Friends' Academy in Philadelphia. During the American Revolution he remained loyal to the crown, firmly convinced that the future of the new country would be ruined by the success of the American arms, and it was during the progress of the war that his work of greatest importance 'The History of Pennsylvania' (2 vols., 1797–98) was written. The work is of much value as containing original material and important information, but the narrative is not well sustained. The documents, letters, etc., which he used in writing his history formed a large and valuable collection and became known as the 'Proud Papers.' As such they were sold at public auction at Philadelphia in 1903. Consult Henkels, S. V., 'Catalogue of the Proud Papers' (Catalogue No. 893, Philadelphia 1903); 'Letters of Robert Proud' (in *Pennsylvania Magazine of History and Biography*, Vol. XXXIV, p. 62, Philadelphia 1910); Thomson, C. W., 'Notice of the Life and Character of Robert Proud' (in *Historical Society of Pennsylvania, Memoirs*, Vol. I, p. 391, Philadelphia 1826). Consult Thomson, 'Life and Character of Robert Proud' (in 'Memoirs of the Historical Society of Pennsylvania,' Vol. I, 1826; 1864).

PROUD FLESH. See GRANULATION TISSUE.

PROUDFIT, David Law ("PELEG ARKWRIGHT"), American author: b. Newburgh, N. Y., 27 Oct. 1842; d. New York, 23 Feb. 1897. He enlisted in the Union army as a private in 1862, was commissioned lieutenant-colonel of colored troops and served through the war. He afterward entered business, became interested in pneumatic tube experiments and later was president of the Meteor Dispatch Company. He was a frequent contributor to newspapers and magazines. His poems enjoyed a great vogue amongst recitationists. His publications include ‘Love Among the Gamins’ (New York 1877); ‘Mask and Domino’ (Philadelphia 1888); ‘From the Chapparal to Wall Street; or a Man from the West’ (New York 1891).

PROUDHON, proo'dôn, **Pierre Joseph**, French philosophical anarchist: b. Besançon, France, 15 July 1809; d. Passy, Paris, 16 Jan. 1865. He studied at the University of Besançon, but left without completing his course there because compelled to find some means of self-support. He then learned printing and in 1837 became partner in developing a new typographical process. He had continued his education by improving every opportunity for study; and in 1838 published a philological treatise, ‘Essai de Grammaire Générale,’ for which the Academy of Besançon conferred on him a pension which yielded an income of 1,500 francs for three years. Political economy now became his chief study, and in 1840 appeared his famous work ‘Qu'est-ce que la Propriété?’ (‘What is Property?’), to which question the first page of the treatise contains the answer, “La Propriéte c'est le Vol” (“Property is theft”). This first treatise was followed in 1841 and 1842 by two pamphlets in the same strain, the second of which, ‘Avertissement aux Propriétaires,’ led to his prosecution and trial for his revolutionary opinions, resulting in an acquittal. In 1843 Proudhon undertook the management of a system of transports on the Rhone and Saone. But he still continued to write. In that year appeared his treatise ‘De la Création de l'Ordre dans l'Humanité,’ a proposed system of political organization; and in 1846 ‘Système des Contradictions Economiques’ on ‘Philosophie de la misère.’ In 1847 he moved to Paris and soon became one of the best-known radicals. After the revolution of February 1848 he began the publication of a journal at Paris called *Le Représentant du Peuple*, which, however, was speedily suppressed. But he had by this time acquired so much popularity that he was elected the representative of the Seine in the Assembly. Here, however, he had little success, and again turned to writing and journalism. He published several pamphlets, and started three journals in succession, *Le Peuple*, *La Voix du Peuple* and *Le Peuple de* 1850. He was frequently fined for his statement of his radical theories, but the fines were paid for him by subscription. In 1849 he attempted to found a bank under the name of the “Banque du Peuple” with the object of abolishing interest and finally putting an end to capital. This project failed, and he fled to Geneva to escape imprisonment for violation of the press laws, but returning in June 1849 was imprisoned for three years. On his release in 1852 he went to Belgium, where he continued to write and in 1860 under an amnesty returned to Paris, where he lived in retirement till his death. His publications in addition to those already mentioned include ‘De la concurrence entre les chemins de fer et les voies navigables’ (1845); ‘Solution du problème Sociale’ (1848); ‘Résumé de la Question Sociale; Banque d'Echange’ (1849); ‘Idées Révolutionnaires’ (1849); ‘Organisation de crédit, etc.’ (1849); ‘Confessions d'un révolutionnaire’ (1849); ‘Actes de la révolution’ (1849); ‘Banque du peuple’ (1849); ‘Intérêt et principal’ (1849); ‘Gratuité du crédit’ (1850), the last two a resumé of discussions he had with Bastiat (q.v.) on the subject of interest; ‘Le droit au travail et le droit de propriété’ (1850); ‘De la célébration du dimanche’ (1850); ‘Idée général de la révolution aux 19e Siècle’ (1851); ‘La révolution sociale demontrée par le coup d'état’ (1852); ‘Philosophie du progrès’ (1853); ‘Manuel du spéculateur à la Bourse’ (1856); ‘De la justice dans la révolution et dans l'eglise’ (3 vols., 1858); ‘La guerre e la paix’ (2 vols., 1860); ‘Théorie de l'Impôt’ (1861); ‘Les majorats littèraires’ (1862); ‘La fédération et l'unité en Italie’ (1862); ‘Du principe fèdérative, etc.’ (1863). The following works of his have been published posthumously: ‘De la capacité politique des classes ouvrières’ (1865); ‘Théorie de la propriété’ (1865); ‘Du principe de l'art’ (1865); ‘Le Bible Annotée’ (2 vols., 1866–67); ‘France et Rhin’ (1867); ‘Contradictions politiques’ (Paris 1870); ‘Du principe de l'art, etc.’ (1875); ‘La pornocratie, etc.’ (1875); ‘Césarisme et christianisme’ (2 vols., 1883); ‘Jésus et les Origines du Christianisme’ (1896); ‘Napoléon I’ (1898); ‘Napoléon III’ (1900). A collection of his works, ‘Œuvres Complètes,’ has been published (37 vols., Paris and Brussels 1866–83), and an abridged edition, ‘Abrégé des œuvres de Proudhon’ (Paris 1897). His correspondence has been edited by J. A. Langlois (14 vols., Paris 1875). Only a few of his many writings have been translated: ‘What is Property?’ (translater by B. R. Tucker, Princeton, Mass., 1876); ‘System of Economical Contradictions; or the Philosophy of Misery’ (translated by B. R. Tucker, Vol. I, Boston 1888).

He was the first to formulate the doctrines of philosophical anarchism; he maintained that property was unjustifiable, that labor only should give just claim to share in the product of labor, and that consequently rent and interest should not exist. He thus far agreed with the socialist doctrine of value, but he was neither a socialist nor a communist; because the state depended upon and protected property he claimed that the State must be destroyed; and that the proper basis of society was a voluntary contract between individuals.

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PROUSTITE, or **RUBY SILVER,** Ag_3AsS_3, the most beautiful silver mineral and one of the most important ores of silver. It occurs in acute rhombohedral, or, less commonly, in prismatic crystals, also massive. Its lustre is brilliant adamantine, typical color cochineal-red, but changing to nearly black on exposure to light, losing simultaneously much of its transparency. Chemically, it is silver sulpharsenite, the silver percentage being 65.4. In the rich silver mines of Chile it is one of the chief ores and magnificent crystalized specimens worth thousands of dollars have been taken out. The royal Saxon mines are also celebrated for their ruby silver, and it occurs as an ore in many European, Mexican, Colorado and Nevada silver mines.

PROUT, prowt, **Ebenezer,** English composer and writer on musical theory: b. Oundle, Northamptonshire, 1 March 1835; d. Hackney, London, 5 Dec. 1909. He was educated at University College, London. From 1860 till 1884 he was a professor of the pianoforte at the Crystal Palace School, and in 1876–82 professor of harmony and composition at the National Training School for Music. He occupied a similar chair in the Royal Academy of Music and the Guildhall School of Music, and from 1894–1909 the chair of music in Dublin University. From 1876 to 1890 he was conductor of the Hackney Choral Association which under his guidance became soon one of the most prominent concert-giving institutions of London. His compositions include cantatas, concertos, quartets, symphonies, overtures, etc., among the first named being ‘Hereward’ (1878); ‘Alfred’ (1881); ‘Red Cross Knight’ (1886); and ‘Damon and Phintias’ (1888). He also edited several of Handel's oratorios and made many pianoforte arrangements of oratorios. Among his theoretical works are the following: ‘Instrumentation’ (1876); ‘Harmony’ (1889); ‘Counterpoint’ (1890); ‘Double Counterpoint and Canon’ (1891); ‘Fugal Analysis’ (1892); ‘Fugue’ (1892); ‘Musical Form’ (1893); ‘Applied Forms’ (1895); ‘The Orchestra’ (2 vols., 1898–99). He was the first editor of the *Monthly Musical Record* (1871–74), a frequent contributor to musical journals, and musical critic of the *Academy* (1874–79) and of the *Athenæum* (1879–89). Dublin University gave him the honorary degree of Mus.D in 1895. Consult Anon., ‘Ebenezer Prout’ (in *Musical Times,* Vol. XL, No. 674, p. 225, London 1899).

PROUT, Father. See MAHONY, FRANCIS, SYLVESTER.

PROUT, Samuel, English painter: b. Plymouth, 17 Sept. 1783; d. Camberwell, 10 Feb. 1852. He early manifested a turn for drawing, but the only lessons he received were from a drawing-master in his native town. In 1801 he made the acquaintance of Britton, the architectural antiquary, who employed him in visiting the rural districts to make sketches, which were to be engraved in the ‘Beauties of England,’ but which finally were rejected. Later sketches, however, were used in that work. In 1818 he visited Normandy, returning with many striking water-color drawings, whose merits placed him at the head of this department of art. He was especially happy in depicting monuments of mediæval architecture throughout France, Germany and Italy, and also directed his attention to lithography, publishing several collections of lithographed sketches. He was a great water-color painter, in the English sense of the term, and relied altogether upon wash tones, whose depth was determined by the degree to which the white paper on which they were laid was permitted to appear. The principal features of his buildings he marked with strong lines and deep shadows; but his main characteristics are breadth, freedom of handling, and power of coloring. He was one of the most active members of the Water-color Society and a regular exhibitor. His industry was great and his pictures were eagerly sought for, though he received only moderate prices during his lifetime. However, in 1868 his ‘Nuremberg’ (21 x 28 in.) was sold for $5,010. He is the author of ‘Hints on Light and Shadow,’ the ‘Young Student's Drawing Book,’ and a series of lesson books published by Ackermann. A number of his water colors are in the South Kensington Museum, London. Consult Ruskin, J., ‘Notes on Samuel Prout and William Hunt’ (London 1880); Winslow, H., ‘The Drawings of Samuel Prout’ (in *American Institute of Architects, Journal,* Vol. IV, p. 485, Harrisburg 1916).

PROUTY, Charles Azro, American lawyer: b. Newport, Vt., 9 Oct. 1853. He was graduated at Dartmouth College in 1875 and in 1882 was admitted to the bar in Vermont. He was engaged in law practice at Newport, Vt., in 1882–96; served in the Vermont House of Representatives in 1888; and was a reporter of decisions of the Supreme Court of Vermont in 1888–96. In 1896–14 he was a member of the United States Interstate Commerce Commission, serving as chairman in 1912–13; and since 1914 he has been director of valuation for the Interstate Commerce Commission. He was appointed director of public service and accounting on the staff of the Railroad Administration, Washington, D. C., in February 1918.

PROVANCHER, prō-vän-shĕr, **Leon,** Canadian naturalist: b. Bècancour, Quebec, 10 March 1820; d. Cap Rouge, Quebec, 1892. To devote himself exclusively to the pursuit of botany and kindred studies, he retired from the Catholic priesthood which he had entered in 1844. He established ‘Le Naturaliste Canadien’ in 1868, and published ‘Traité Élémentaire de Botanique’ (1858); ‘Flore Canadienne’ (1862); ‘Le Verger Canadien’ (1865); ‘De Quebec à Jerusalem’ (1882); ‘Petite Histoire du Canada’ (1887); ‘Une Excursion aux Climats Tropicaux’ (1890).

PROVENÇAL (prō-vän-sal) **LANGUAGE.** The term is used in two distinct significations, according to one of which it embraces only the speech of Provence; while according to the other, it includes the dialect not only of Provence but of all the neighboring districts of southern France where the langue d'oc is spoken, The term is even intended to include, in a literary sense, the sister dialects of Catalonia and the eastern coast of Spain in general and northern Italy. The term Provençal was applied to the literary language of all the sister dialects of southern France because of the early prominence of Provence in the literature of the early provençal period. Between 8,000,000 and 10,000,000 people speak Provençal using the term in its broader signification and including the Gascon dialects, which local jealousies have been inclined to look upon as a speech apart from Provençal, on account of its French peculiarities and its inability to identify itself with the dialectic and literary movement of southern France.

Provençal is distinguished from French noticeably by its tendency to strongly accentuate one syllable of a word at the expense of the others instead of more or less equally distributing the accent over all the syllables. This accent almost always rests on the ultimate or penultimate syllable; and in this respect Provençal resembles Spanish and Portuguese more than it does French. French has changed the Latin accented *a* of free syllables to *e*, and the Latin unaccented *a* to mute or slurred *e*, while the Provençal has retained the Latin form changing, however, in modern Provençal the final unaccented *a* into *o*; as far example, Provençal *amat*, French *aimé;* Provençal *bona*, French *bonne*. Another feature of Provençal which tends to connect it with the dialects of southern and eastern Spain is the tendency to convert the palatalized *l* into the palatal vocalic *y*, a tendency noticeable in Cuba and most of the central and South American countries. The lack of nazalization in vowels distinguishes Provençal from French and Portuguese and helps to relate it more to Spanish and Italian. As a result of this nazalization Latin final consonants have a tendency to disappear in Provençal even when they are retained in French and Portuguese or converted into vocal endings in Spanish and Italian; as for example Latin *bonum.*; French *bon*; Portuguese, *bom*; Spanish *bueno;* Italian *buono;* Provençal, *bo*. But Provençal is like French in that the *s* used as the sign of the plural, is silent, where as in Spanish it is pronounced; but unlike it and the other Romance languages, in its retension of the Latin diphthong *au*. Examples: Latin *aurum*, French *or;* Provençal *aur;* Latin *pauperem;* French *pauvre*; Provençal *paubre*. In this latter example although the French preserves the Latin *au*, in the spelling, in effect, it has not since the au pronounced as though it were written *o*. A general tendency of the Provençal dialects is to change the Latin termination following *an*, in open syllables into open *o*. Examples:

Latin	French	Spanish	Provençal.
granum	grain	grano	gro
manum	main	mano	mo
panem	pain	pan	po.

Another peculiar feature of Provençal is the change of the Latin *a* (following the tonic accent) into *o*. Example:

Latin	French	Spanish	Provençal
terra	terre	tierra	terro
amata	amie	amado.	amado

It must be constantly kept in mind, in any study of Provençal that not only was the ancient literary language much like the modern, but that in it as in the present speech there were many variations due to dialects and local conditions, hence the tracing of the phonology, morphology and texts of Provençal is largely a matter of noting these many local variations, and undertaking not profitable for the general reader, because so few of these variations are common to all the Provençal dialects and at the same time distinctly different from the other Latin tongues. This constant dialectic variation in High Limousin, Law Limousin, Marchese, Auverguese, Gascon, Bearnese, Roygerat, Languedocian and Provençal proper has made the task of creating a modern Provençal literature very difficult. The leaders of the modern movement have, to a certain extent, disregarded the tendencies of the natural growth of languages and they have attempted to create a so-called pure Provençal by the exclusion of words of foreign origin and also of those formed from Provençal through French influence. The literary men of the modern Provençal school write in a literary tongue that is the speech of none of their readers. The lack of a Provençal school system and the constant and ever increasing encroachment of French upon the Provençal and other dialects and the indifference of the greater part of the masses to the literary future of their tongue, all tend to make a losing one of the battel the Félibres have been fighting, since the middle of the 19 century, for the revival of Provençal as the literary and folk tongue of southern France. The extension and improvement of the French school system and the consequent increase of literacy throughout the land, are slowly but surely creating a national sentiment and a feeling of unity such as may be said to have never before existed in the country. The European War has made France realize, as probably no other one factor could have done, that her people are one and indivisible and that there is no room for a supreme non-national tongue in the south or in any other part of France. Hence the Provençal tongues seem destined to disappear ultimately, not only from France but also from Spain and Italy. For the history of the Provençal movement in modern times see FÉLIBRES, and consult articles on PROVENCAL LITERATURE; CATALONIA; TROUBADOURS; Appel, Karl, 'Chrestomathie'; and the publication *Annales du Midi* (Toulouse); *Revue des langues romanes* (Montpellier); *Romania* (Paris); *Romanische Forschungen* (Erlangen); *Zeischrift für rümanische Philologie* (Halle).

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PROVENÇAL LITERATURE made its appearance in southern France toward the close of the 11th century; although previous to this date there undoubtedly existed ballad and other verse in the vernacular of the masses, which seems to have been handed down from one reciter or singer to another and not to have been committed to writing. At this time Latin formed the sole literary medium of the poets and other writers who lived the life of the court and courtly society. But while Latin maintained its entrenched position as the vehicle of the literary expression of the court and the nobility, the masses were shaping the Romanic tongue of southern France to their own ends. Just when this new tongue began to take form as a speech apart from Latin and the native language spoken in the country on the advent of the Romans is not known, but a considerable fragment of a poem of the first half of the 11th century which has been preserved shows that at this time the provençal had already assumed a strong individuality of form and a grammatical structure very different from those of the Latin tongue. This poem consists of 257 decasyllabic verses forming the beginning of a composition based on Boethius' 'De consolatione philosophiæ.' It is evident that the author was acquainted with Latin, which probably influenced his handling of the vernacular; and the form of the poem suggests that it was composed to be sung or recited probably by some professional entertainer. This poem is of considereable interest, since it shows that the importance of the vernacular had already become great enough to induce a court writer to revamp, in the popular speech, the work of a noted Latin author, and also because it indicates that, while Christianity had already got the upper hand of Roman paganism, yet the pagan writings, reshaped and commentated, were still serving to entertain the Christianized public.

The poems of William IX, Count of Poitiers, consisting of love songs and occasional compositions of various kinds, which belong to the end of the 11th and first quarter of the 12th centuries, are the earliest extant representatives of the Provençal literature which was soon to become so popular in southern France and the east of Spain. The form of these poems shows they were intended to be sung, probably at the court, to the courtly friends and guests of the sovereign, since the subjects are in no sense popular. They bear evidence that the Provençal tongue had already by the end of the 11th century become the language of the people of southern France, peasant and prince alike. Their lack of resemblance to Latin poetry would seem to prove the contention that they were imitations of the compositions of the joglars (*jongleurs*) or professional entertainers, who were welcome guests at the castles of princes and barons. William of Poitiers seems to have set the style in vernacular poetry for the Provençal writers who followed him. Those love poems in which profound respect is shown by the poet to his lady love, or to some lady of higher rank, perhaps the head of the household or court to which the singer was attached. These poetic effusions were always couched in the most respectful terms and in the highest refinement of language at the command of the poet. Growing up under these conditions and flourishing among the court followers and the families of the barons and knights, Provençal poetry remained, as it was when it first came into notice, the possession of the privileged class. It was, therefore, undoubtedly more refined and Latinized than the speech of the masses. This explains the fact that, after a comparatively long period of vogue and noted popularity, it dropped almost completely out of sight for several centuries. Provençal poetry received its first encouragement and inspiration at the court of William of Poitiers, at a time when it had already acquired sufficient strength, character and individuality to fit it to be the medium of the expression of the life and aspirations of the court and its followers. The example set by the royal poet of writing in the vulgar tongue, to the exclusion of Latin, was followed by many writers, not a few of whom were of noble birth. The writing of poetry was soon looked upon as a courtly accomplishment; and it naturally became fashionable. It would seem as if every one at court wrote or tried to write songs, generally of love. Very often the author also composed the music to which his songs were sung either by himself, his friends or professional singers and reciters. Songs of over 400 Provençal poets have been preserved while the poems of many more writers known by name or reputation have been lost. The very respectable body of Provençal poetry that has survived is a good indication of the great amount written during the period of its vogue. Being the expression of the sentiment and an idealization of the life of the court, the work of the Provençal poets could never have been popular in the sense that a modern poet is popular; and it is doubtful if it ever penetrated to the masses. Confined to the narrow court circle and idealizing to the extreme a life that was none too ideal, Provençal poetry rapidly became artificial and more and more characteristically the voice and the peculiar property of the aristocracy. This result was undoubtedly due to the illiteracy and low condition of the masses who were very far from the ideal condition pictured by the poets of the age. As

Provençal poetry became more and more artificial it lost considerable of its virility and much of its earlier and charming appearance of naturalness. Its tendency was to assume a stereotyped form from which succeeding poets found it very difficult to break away. It was so inseparably identified with the court life and the ideals of the Provençal aristocracy that, when the latter fell from its high estate on the subjugation of the Provençal domains in the 14th century, the ornate literary branch that had been grafted on its ancient family tree fell by the wayside and perished with the local feudalism it had been used to glorify. But its own peculiar glory did not die with it; for it had already impressed its peculiar mode of thought, its idealism, its literary artificiality on the feudalism of Europe; and left its impress strongly and indelibly upon the literature, prose and poetry alike, of France, Germany, Italy and Spain. The Provençal literary movement during this first or aristocratic period embraced not only the French Provençal country but also Catalonia and the outer east coast countries of Spain in which Catalan was and still is the native tongue, Gascony and northern Italy. In all these regions it showed the same characteristics; and in none of them was it ever the expression of the life of the masses; nor did it ever deal with the legend story or the history of the earlier life of the people. In this respect the early literature of northern France was superior in rugged strength, in human interest and real dramatic qualities.

Aristocratic Period.— Although the poetry of this period was largely lyrical, it naturally, during its more than 250 years of existence, reached out into other fields. Religious, epic, narrative, didactic and dramatic poets there were in the Provençal countries; but even in these the lyrical influence is strongly in evidence, for the habit of public singing and recitation had fixed upon the poetry of the age certain easily recognizable marks which it continued to bear so long as it remained under the influence of feudalism and the artificial rules it had set up for the government of literature, not formally, of course, but unconsciously, yet none the less inexorably. Lyrical poetry being the fountain head of Provençal literature is, naturally, its most characteristic expression. It was symbolical of the life of the court and of the chivalric spirit of the age to such an extent that the French word «courtoise» was often used in the sense of «lyrical»; that is to say, that form of poetical expression which belonged particularly to the court, which had under the influence of chivalry developed complicated and highly artificial court manners generally referred to as courtesy. Gentle courtesy was the court manners of the gentle born. Of this the lyrical Provençal poetry was the expression in a very particular sense, not only in France but also throughout the other countries in which the Provençal tongue was dominant. It was this lyrical poetry, too, which appealed to the poets of Europe and set the style for poetry for years and later on for romances in prose. Love and the faithfulness, purity and devotion of the knight to the lady of his choice was the principal theme of Provençal lyrical poetry. This was carried to such an extreme that it became almost a cult; and as such it has left its impress upon the Latin and Saxon countries to-day in such a manner as distinctly to differentiate them from the other peoples of the world in their treatment of woman who was for the Provençal poet the centre and soul of all things courtly and chivalric. How much of this feminine sentiment was due, as French critics contend, to the powerful influenece of clever women during the most active period of Provençal literature it is, at this late date, hard to determine. It is certain, however, that Eleanor of Poitiers, at whose court the best of the Provençal poets were welcomed, inspired these singers to sound her praise and that of courtly women in general. This undoubtedly had a very strong influence on the general trend of lyrical poetry at this time. Eleanor, who was the wife of Louis VII of France and later on of Henry II of England, was a woman of excellent literary taste and sound judgment. As the consort successively of two of the most powerful sovereigns of her day; and possessed of the tongue of Provençe and the sympathies of her people, she exercised a powerful influence upon the life of her day in France; and the glamor of her name, her gifts and her courtesy spread to other countries, especially to Catalonia and northern Italy, from whence came noted vernacular poets to her court. Eleanor of Poitiers was to the most brilliant Provençal period what Queen Elizabeth of England was to her own time. Thus it was quite natural that, in an age of chivalry, a powerful, clever, ambitious and popular woman like Eleanor should set the ideal of the perfect woman before the eyes of the court poets in such a way that they never afterward lost the vision so long as the system upon which Provençal poetry depended continued vigorous and dominant.

One of the most noted of the Provençal lyrical poets was Bernart de Ventadour, one of the singers at the court of Eleanor of Poitiers. Some 50 or more of his songs which have survived are distinguished by their sincerity and passion; and their elegance of form and expression justify the judgment of his age which ranked him as one of the most inspired poets of his own day. Another poet who lived about the same time and who seems to have had great popularity and to have exercised strong influence on Provencal lyrical poetry was Cercamon, a Gascon who wrote «pastorals» in the popular tongue in an original style and with considerable originality of thought and forms of expression. At the court of Richard Cœur de Lion, himself a great lover of music and song, there were noted Provençal poets, Arnaut Daniel, Peire Vidal, Folquet of Marseilles and Gaucelm Faidit, some or all of whom undoubtedly entertained the Crusaders on their long and venturesome journey. Bernart de Ventadour, already mentioned, appears to have been also at the courts of Ermengarde of Narbonne and Raimon V, Count of Toulouse. The other Provençal poets seem also to have gone from one Provençal court to another and even some of them were invited to the courts of France and Castile. Among the patrons of the Provençal period, in addition to those already mentioned, were in France, Raimon VI, Count of Toulouse; Alphonse II, Count of Provence; Raimon Berenger IV, also Count of Provence;

Barral Marseilles; William VIII of Montpellier; Robert of Auvergne; William du Baus, Prince of Orange; Savario de Mauléon; Henry I and Henry II, counts of Rodez; Nunyo Sanchez, Count of Roussillon and Bernard IV, Count of Astarac. In Spain the courts of Alphonse II, Pedro II, Jamie I, Pedro III, kings of Aragon; Alfonso IX of Leon and Alfonso X of Castile extended the strongest sympathy and aid to the Provençal poets; and some of these sovereigns, like Jamie I, entered actively into the lists for literary honors. Hence all the great names in the first period of Provençal literature are inseparably connected with one or several of these courts, or literary centres.

Arnaut Daniel, considered by his contemporaries as the most gifted poet at the court of Richard Cœur de Lion, was greatly admired by both Petrarch and Dante. He was the originator of the «sestina» and, incidentally, a lover of complicated and intricate versification, both of which he succeeded in making popular. Arnault of Mareuil, noted for his delicacy of style, symplicity and felicity of expression, had many of the qualities of a good poet, and his surviving work commends itself to the modern reader. Bertran de Born, a noted poet who lived at the court of Henry Curtmantle, son of Henry II of England, was a famous soldier, as well, who is said to have been known to all the courts of Europe of his day where Provençal poetry was known. He gained additional notoriety by the prominent part he took in the quarrel between Henry and his unruly sons. Peire Vidal of Toulouse, who was well and favorably known at all the Provençal courts, was looked upon as one of the greatest singers of his day, and in addition to being one of the favorite troubadours of Richard Cœur de Lion, was on especially good terms with Raimon V of Toulouse and Barral of Marseilles, where his striking poetical gifts and his knowledge of the ways of the court and his natural tact made him a general favorite and incidentally enabled him to become one of the richest of troubadours. Girault de Borneil, who has been termed the master poet of the troubadours, was distinguished for simplicity of style and other attractive poetical gifts. He was a great master of the *trobar clus* (close verse) which he made popular. Gaucelm Faidit, one of the favorite troubadours of Richard Cœur de Lion, has left, among other short poems of merit, a touching lament on the death of the great Crusader whose exploits caught the fancy of the Europe of his day and held it for several generations. Among the numerous troubadours of good family was the famous Folguet of Marseilles who later became bishop of Toulouse, and in that capacity savagely persecuted the Albigenses, all forgetful of the passionate love songs he had sung in his youth, and the gentle ways of the court for which he had distinguished himself. Although many troubadours arose among people of lower rank yet, especially after the profession became famous and kings like Jamie I of Aragon had lent it dignity by composing troubadour songs themselves, many men of noble birth entered the ranks of the poets; and of these not a few became professional troubadours. Among these were Raimon de Miraval who became one of the most popular troubadours of the court of Pedro II of Aragon, and, later, of that of Raimon VI, Count of Toulouse; Guillem Azemar and Raimbaut de Vacqueiras, a favorite at the court of Guillaume du Baus, Prince of Orange, in the latter half of the 12th and the beginning of the 13th centuries. But the patrons of the troubadours were no respectors of rank when it became a question of the recognition of the gifts of poetry and song. Bernart of Ventadour won the love of the lady of Ventadour through his wondrous lyrical gifts, and when he had to flee from the court, he found like favor in the eyes of the more famous Eleanor of Guienne. Yet he was the son of a house servant. Several troubadours were sons of trades-people, bourgeois, scriveners, clerks and persons in a position to give them at least the rudiments of education. Others began their poetical work as students as a means of paying expenses and continued at it because it appealed to them; while another very considerable class of troubadours consisted of needy younger sons of noble families who found the wandering life of the troubadour a very pleasant means of making a living. On account of the high connection of this class of singers their existence at all the courts was agreeable, since it brought them constantly into public prominence without the restrictions of rank imposed upon gifted poets of more humble birth.

Marcabrun shows in his surviving poems that the age in which he lived was as appreciative of biting satire as the France of to-day. Pons de Capdoil, Raimbaut de Vacqueiras and Peirol, all Crusaders, were writers of excellent love songs which helped to swell the fame of the Provençal troubadours and their art. After the first century of brilliant success the quality of Provençal literature began to depreciate. The earnestness and enthusiasm of the earlier poets had been replaced by the artificiality and more or less stereotypes of succeeding generations who continued to follow the fashion set by the predecessors. The opening of the Albigensian Crusade in 1209 was the beginning of a movement which finally destroyed the power of the independent principalities of southern France, broke up the Provençal society and caused to disappear the centres in which the troubadours found welcome and support, and finally destroyed the Provençal tongue as an official speech and the vehicle of poetical expression. The French power, language and culture overran the Provençal countries and the troubadours and other Provençal poets disappeared almost suddenly about 1350.

Middle Period.— After the overthrow of the southern French principalities and the disappearance of the court troubadours Provençal literature, as the medium of expression of the aristocracy disappeared; but it did not altogether die out. As the courtly bonds which had bound it together into one homogeneous whole, that made the troubadour at home in southern France, eastern and southeastern Spain and northern Italy, were cut, and the patronage of the nobles and princes was withdrawn, the heritage of Provençal literature fell to the masses, who wrote more or less in the language of the country. As each district made use of its own dialect, the old uniformity disappeared; and thus provençal literature lost its former prestige and all but very local interest, the work excepted, of a few singers and reciters who still made the rounds of the country appearing at the castles of the local nobility, town fairs and other places where crowds of people met together. Owing to the lack of encouragement and patronage, and its dialectic character, this literature was vastly inferior in quality, if not in quantity, to that of the period of the troubadours. The overthrow of the Provençal principalities also made it necessarily different in plan, form, composition and objective. After the disappearance of the brilliant Provençal courts with their charming and cultured ladies, their heroic and chivalrous knights, their cultured centres, their poet-princes and their literary contests, the reason for being of the troubadours and their semi-artificial language and literature largely ceased to exist. The troubadours themselves migrated to the Provençal countries of Spain and Italy where they found a short respite from the fate that was rapidly overtaking their whole literature. But although the unity of the Provençal effort was thus broken an effort was made by the Academy of Toulouse (founded 1324), to encourage the literary use of the tongue of the troubadours. Prizes and literary contests were offered and literary titles were given to the successful contestants. Even after the discovery of America this society was still as active as it dare be, and throughout the centuries since then it seems to have maintained some sort of existence, though certainly not a very active one. Gradually, however, the French influence, even in this native society, gained the upper hand and succeeded in finally shutting out the Provençal from participation in its contests or sharing its honors (1670). The latter, left to itself, developed along the line of least resistance. Scarcely had the stream of courtly poetry ceased to flow, arrested and finally dried up at the fountain-head by the inflow of French culture, when the Provençal districts became active in directions that had begun to make themselves noticeable before the overthrow of the troubadours. While, as already stated, the distinguishing feature of the literature of the period of the troubadours was the prominence of lyrical poetry to the practical overshadowing of every other department of literary endeavor, yet Provençal showed, especially toward the latter half of this period, considerable activity in other departments of literature. Numerous epics belong to this period. Some of them were quite lengthy, though they have survived in only a fragmentary form. Various tales and romances presenting the life of the period, allegories, didactic poems, lives of the saints and other similar religious compositions of a moral nature occupied the attention of a class of writers of an inferior order, who apparently could not aspire to be troubadours. Between these and the troubadours was a body of romancers, some of whom at least found favor at the court. These composed lengthy poetical tales in the manner of the stories of Arthur and other heroes of lengthy romance. There is every reason to believe that these romances were popular in their day and probably outlived their authors, though perhaps not everywhere strictly in their original form. The 'Biographies of the Troubadours,' which gives the lives of over 100 of the more popular of these poets, reads more like romance than a sober statement of facts. But it is of interest because of its subject and the added fact that it is in prose while most of the literature of the age was in verse form. 'Flamença,' a very long and artificial love story, instinct with the life of the period in which it was written (during the first quarter of the 13th century), shows the Provençal mind working along the line of romantic tales of intrigue later on developed by the Italian writers. Much in the same form is the long historical romance, the 'Chanso d'Antioche,' whose inspiration was the first Crusade, with its glamor of tradition and its stirring adventures. The period that followed the disappearance of Provençal as a court literature continued to imitate the literature of the preceding period; but the work produced, which was didactic, religious or educational, was of a very poor quality and served from the literary standpoint only to keep alive the habit of and facility in writing. For over 100 years little of interest appeared in Provençal literature, except a number of mystery plays dealing with religious subjects. There was a tendency for each writer to make use of his own dialect to the neglect of the literary Provençal. This 100 years, devoid as they were of literary fruit of even mediocre value, were a preparation for a movement that promised to be in a sense more national than the literature of the troubadours. The leader of this new movement, Pey de Garros (b. about 1500; d. 1581), a Gascon, and a great lover of his native country and dialect, did his utmost through his long life to encourage the use of his maternal speech in literature. To this end he translated the Psalms into Gascon (1565) and wrote many poems. To this movement to restore the tongue of the south there adhered, among other writers of talent, Louis Bellaut de la Bellaudière (1532–88) and Claud Brueys (1570–1660); in Languedoc also Pierre Goudelin (1579–1649); David Sage (middle of 17th century); the avocat, Bonnet de Béziers (active 1616–57), and François de Cortete (1571–1655). This movement was carried on, not only without support from those in authority but with the avowed opposition of the French court. There was talent enough in the south at this period, had the writers worked together, to have made itself felt strongly all over the Provençal countries. But there was no unity of effort or aims and a surprising amount of most promising literary talent was dissipated and in a sense neutralized in more or less petty regional aspirations, jealousies and misunderstandings. 'Le Don-Don internal' (1588), a collection of humorous poems made by Bellaud, illustrates well the spirit of the times throughout the Provençal country. It was very popular and ran through several editions. Brueys, whose 'Jardin deys musos provensalos' was published in 1628, presents a very varied program of poetic effort which includes comedies, songs, ballets, carnival pieces and occasional poems, and was immensely popular in his day. But for real merit he was surpassed by other contemporary Provençal poets. Among the writers of comedy of this period were Gaspard Zerbin, Jean de Cabanes (1653–1712), Seguin de Tarascon (middle of 17th century), Nicolas Saboly (1614–75) and Bonnet de

Béziers. Saboly, who also entered other poetic fields, and whose works have passed through several editions, is still read in France; and the Félibrige movement has tended to bring him into vogue once more. 'Las Foulies dau Sage de Mounpelié' (1650) of David Sage; and 'L'Embarras de la foire de Beaucaire' of Jean Michel of Nimes, popular and much overestimated by their contemporaries, contain too many obscurities for modern taste. In almost every respect they are inferior to the work of Goudelin and Bonnet. The latter was the cleverest of a number of writers who made their headquarters in Languedoc and wrote in the dialectic of that district. He was master of lyrical tragic and comic poetry. Among his works are 'Jugement de Pâris' (1616), a tragiccomedy, and 'Histoire de Pépésuc, an allegory. 'Lou Ramelet Moundi' (1617) of Pierre Goudelin of Toulouse was one of the books of the age that became popular wherever Provençal was spoken. He was a very prolific writer who gave all his time and energies to literature, almost every branch of which he attempted, generally with success. Odes, masques, songs, sonnets and occasional poems he wrote in a masterly style which attracted to him attention throughout France and made him the most favorite poet of Languedoc. Numerous editions of his works have appeared and translations of his most characteristic poems have been made into most of the languages of Europe. In his day he had a very large following and many imitators. Of these Jean Guiraud-Dastros was one of the best. His 'Trinfe de la langue gascoune' (1642), which is still read, and which has gone through many editions, contains very natural and entertaining descriptions of the life and customs of the country. François de Cortete (1571–1655), of Prades, shares with Goudelin the reputation of being the best Provençal writer of the 17th century. His works, which have been looked upon as models for style and linguistic correctness, have never ceased to be read since his day. Among them are 'Ramounet' and 'Miramoundo,' two comedies.

During the 18th century the standard of Provençal literature declined in originality of subject, form and purity of language. Most of the writers were little more than imitators of the popular poets of the preceding generations. Yet here one meets with a writer who departs enough from this monotonous routine to attract attention. Among these are the Abbé Favre (1727–83), author of 'Siège de Caderousse and 'Lou Sermoun de moussu sistre,' and Claude Peyrot, prior of Pradinas (1709–95), who wrote 'Los Quatre sosous.' Both of these authors are witty and jovially good-natured to a degree scarcely to be expected of ecclesiastics. To these should be added the name of Cassanea de Mondonville, whose play 'Daphnis et Alcimadure' became immensely popular not only in the Provençal countries but throughout France; and finally had the honor of being played, by invitation, before the king, Louis XIV. In Provence and Gascony there were poets of much natural talent who, under more favorable circumstance, or even a little encouragement from the French court, might easily have made Provençal literature approach the popularity of the days of its prosperity. But the lack of a spirit of unity here, as in the preceding centuries, caused most of these to fall by the wayside. Their eyes were ever so near to the ground that they failed of the vision that is ever necessary to make great poets.

Yet there ever continued to exist in the Provençal countries a spirit of racial pride in their customs, history, language and literature which was kept alive by writers and speakers, generally of mediocre talent. The study of the *language d'oc* was kept by enthusiasts in an unscientific and desultory way, and various grammars, vocabularies and dictionaries of the language were written, though the interest in this kind of work, even by scholars, was so small that often laborious works of this kind remained in manuscript for lack of encouragement to print them. Fabre d'Olivet (1767–1825), scientific investigator, musician, poet, philologist and enthusiast, was forerunner of the Félibrige. He aimed at writing pure Provençal to the exclusion of dialect, and to unite the literary aspirations and efforts of all the Provençal countries. He was a poet and writer of very considerable vision and much talent; and yet he labored from 1787 until the opening of the 19th century to stir up the local enthusiasm and aspirations of his fellow-countrymen before he finally succeeded in catching the public fancy. But finally he succeeded in driving home the lesson that Provençal, if it deserved to produce a literature worthy the name, must throw aside its various dialectic efforts and set up before itself, as its chief aim, purity of language. He strove to establish a rational orthography *and* to have it generally adopted through the Provençal districts. He made collections of Languedoc poets with explanatory notes and wrote fine poems of his own in the native tongue; and in this way for almost a third of a century he continued to influence the public mind and to educate it in the appreciation of its treasures of early Provençal literature. His work in this direction influenced all the Provençal writers contemporary with him and created for him a large literary following, among whom was Jacques Jasmin (1798–1864), the greatest and most influential of the Félibrige movement. For a study of the modern Provençal movement, see FÉLIBRIGE. Also see CATALAN; CATALONIA; CATALAN LITERATURE; TROUBADOURS.

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PROVENCE, prō-väṅs, a province of ancient southeastern France, bounded by Piedmont, the Mediterranean, Languedoc, Venaissin and Dauphiné, and including what is now the departments of Bouches-du-Rhône, Var, Basses Alpes, and, in part, Vaucluse and Alpes Maritimes. Lesser ranges of the Alps, called the Alpines and in the south the Maures, break up the country. The principal rivers are the Var, Durance and Rhone; the last river has a great marshy delta. Climate and soil vary greatly, from the damp, changeable, rather sterile and stony north to the south with its ideally mild air, its culture of bees and silkworms and its produce of olive-oil, wine, mulberries, oranges, citrons and all southern fruits. There is good sheep-grazing, but other livestock is less successful. The inhabitants of the Provence preserve to a large degree southern characteristics quite foreign to the northern Frenchmen, and keep a language and literature of their own, nearly as much akin to the Spanish and Italian as to the French. See PROVENÇAL LANGUAGE AND LITERATURE.

History.— There are traces in Provence, as in the polished stones found in the Grotte de la Masque and elsewhere, the tunnuli, and dolmens of Draguignan, Pontève and la Blaque, and the lake dwellings of the mouth of the Var, of a civilization as early as the middle of the Stone Age. The Iberians held sway here until the 5th century B.C., when they were finally displaced by the Ligures. Greek and Phœnician colonies, notably Massilia, the modern Marseilles (q.v.), had been founded here at least as early as this. The Greek city of Marseilles by its repeated appeals to Rome for help against the Ligures, first in 155 B.C., effected the introduction of Roman influence, and in 124 B.C. Marcus Fulvius, pro-consul, and Gaius Sextius Calvinus, consul, destroyed the capital of the Saluvii and founded (123 B.C.) on its site the city of Aquæ Sextiæ (modern Aix-en-Provence). Victories over other tribes in the next few years gave all the country between the Cevennes and the Alps to Rome. A Roman province, Provincia Romana, or Gallia Transalpina (or Narbonensis, from its capital Narbo, modern Narbonne), arose, was threatened 15 years later by the invasion of the Cimbri and Teutones, and was racked by the civil war between Cæsar and Pompey, in which Massilia (Marseilles) siding with the Senate was captured and crushed by Cæsar in 49 B.C. The amphitheatre of Fréjus, the theatres of Arles, Fréjus and Orange, the triumphal arches of Orange, Cavaillon, and Carpentras, the temple of Augustus and Livia at Vienne, and the splendid Roman roads through southern France, are remains of the glory of Provence in the first four Christian centuries, when Arles was a great commercial centre and one of the residential cities of Constantine and when Autun and Marseilles were great university towns, Marseilles being the seat of a Greek college and a medical school.

The Visigoths entered Provence in the beginning of the 5th century and about 470 Eurich captured Arles and made it his capital. The Ostrogoths held Provence from 510 to 536, receiving it as the price of their assistance against the Franks, but losing it after a quarter of a century to the growing Frankish Empire. In the 8th century Charles Martel rescued it from the Saracens. In the 9th century Provence was twice a kingdom (see BURGUNDY), and from 934 to 1113 was ruled by the counts of Arles (or of Provence), descendants of Boson whose male line failing in 1113 the country went as a result of the marriage of Provençal heiresses to Berengar of Barcelona. His claim was contested by the Count of Toulouse, who in 1125 by treaty secured Valence, Die, Orange and Venaissin; what had been retained by Berengar went to Aragon in 1162, the Count of Barcelona having come to that crown in 1137. In Venaissin; what had been retained by Berengar IV, the last of the male line, married Charles of Anjou and Provence was a possession of the house of Anjou (q.v.) until 1481, when it was willed to Louis XI of France and lost its separate significance politically, though it was not united with France until 1487 under Charles VIII.

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PROVENCE II, a French transport, sunk by a German submarine in the Mediterranean on 26 Feb. 1916. Over 900 lives were lost.

PROVERB, a short, pithy saying, presenting in striking form a well-known truth. They originate principally in the primitive stages of society, are colloquial rather than literary and constitute a form of folklore common to all races. While certain proverbs have undoubtedly strayed from one country to another the very nature of these pungent characterizations, founded on the common facts, experiences and observations of humanity, ensure their existing in similar form in different countries. New proverbs cease to appear as printed literature takes the place of folklore, the common catch phrase or valued quotation bearing no relation to these bits of wisdom with the stamp of ages of popular acceptance and use. Bacon calls them the «edged tools of speech»; Lord Russell's definition «the wisdom of many and the wit of one» is concise and accurate; as is South's «the experience and wisdom of several ages gathered and summed up in one expression.»

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PROVERBIAL PHILOSOPHY, a once popular didactic work by Martin Farquhar Tupper (q.v.), published in four series 1838–67. It is a series of poems in blank verse, dealing with almost every emotion and condition of life. The book contains many wise sayings, but is for the most part merely padded commonplace. In spite of remarkably extensive sales, both in England and America, it was mercilessly criticized by all serious reviewers. It is claimed that more than 1,000,000 copies were sold in the United States and more than 5,000 per year for many years in England. The most recent American edition was brought out in Rochester, N. Y. (1904). It has also been translated into Danish, French, German and Italian. Consult Anon., 'Tea Table Literature' (in *Fraser's Magazine*, Vol. XLVI, October, London 1852); Tupper, M. F., 'My Life as an Author' (London 1886).

PROVERBS, Book of, a portion of the Old Testament. **Date and Authorship.**— The book of Proverbs is the subject of much discussion in reference to date and authorship. The old view that King Solomon was the author of nearly or quite the whole of the book has been generally abandoned. Two classes of views are widely held at the present day. One is that all of the book or all but the last two chapters was written and compiled before the Babylonian exile. The amount attributed to Solomon varies, but is in any case an appreciable quantity, forming the kernel of the whole. The other view is that most or all of the writing and compilation are to be dated long after the exile, little or no part having been written by Solomon. The completion of the work of compiling is assigned to various dates from about 350 to 180 B.C., the whole composition of the book being supposed to cover not more than a century. There is a growing tendency toward the second view, which is held by most of the very recent writers on the book.

Arguments for Late Date.— The chief argument in favor of the late date of the book is from language, that is, the occurrence of a considerable number of words found elsewhere only in late Hebrew and of words borrowed from the Aramaic. But the number of words which can with certainty be assigned to these two classes is much smaller than is often claimed. Historical indications also urged for the same conclusion are that the book makes no mention of polygamy and idolatry, which were common before the exile, and that it assumes the existence of a distinct class of sages, known as wise men, who are hardly mentioned in the historical and prophetical books before the exile, nor are any results of their activity apparent. These are arguments from silence and therefore, of course, to be used with caution. The resemblance to the apocryphal book of Ecclesiasticus, which is also urged, has little bearing on the question, in view of the well-known habit of the author of Ecclesiasticus of borrowing from other books.

Arguments for Early Date.— In favor of the early date, the chief argument is the thought of the book. The oft-repeated teaching of the book concerning the problem of God's government of the world is this: the good will prosper, the wicked will be punished, in this life. This is generally acknowledged to be the pre-exilic doctrine, while the dominant view of the exile and after the exile is quite different. It is not difficult, however, to suppose that the pre-exilic doctrine had persisted after the exile, in certain quarters, in face of the teaching then current that the wicked prosper and the righteous suffer. Further, the frequent allusions to a king suggest the early date. Many passages speak of him as the promoter of justice and none refer to him as a foreigner. After the exile the sovereignty of Palestine was in the hands of foreigners, with little justice in their administration. The syntax of the book, also, is of the classical, earlier type. The titles in chapter i, 1; x, 1 and xxv, 1, which attribute portions of the book to Solomon represent a tradition, but have not necessarily much authority. In general, the background favors the late date; there is nothing seriously inconsistent with this view. There is no sufficient reason, however, for denying the presence of pre-exilic, and even of Solomonic material.

Divisions of the Book.— As ordinarily viewed, although with some variation, there are eight different portions into which the book is divided, each of which is a separate compilation. These divisions, in the chronological order usually, but not invariably, assigned to them, are as follows: chapter x, 1, to chapter xxii, 16, containing the title in chapter x, 1, «The proverbs of Solomon.» Chapter xxii, 17, to chapter xxiv, 22, called in chapter xxii, 17, «the words of the wise.» Chapter xxiv, 23–34, a similar collection, of which it is said in chapter xxiv, 23, «These also are sayings of the wise.» Chapters xxv–xxix, headed by the statement in chapter xxv, 1, «These also are proverbs of Solomon, which the men of Hezekiah king of Judah copied out,» which division, however, some regard as older than chapter x, 1; xxii, 16. Chapters i–ix, a connected discourse in praise of wisdom, in the form of advice to a son or scholar. Chapter xxx, with the title in chapter xxx, 1, «The words of Agur the son of Jakeh.» Chapter xxxi, 1–9, described in chapter xxxi, 1, as the words probably should be translated, as «the words of Lemuel king of Massa.» Chapter xxxi, 10–31, an anonymous alphabetic poem or acrostic in praise of the ideal housewife. The first division was probably compiled somewhat after the time of Solomon, the fourth is traditionally assigned to the time of Hezekiah, while the last three divisions probably belong soon after the exile. There are no indications of precise date for the other divisions, but on the view adopted all of them are to be regarded as pre-exilic.

Solomonic Authorship.— That the first and fourth divisions are not entirely the work of Solomon is clearly shown by the fact that there are many repetitions of proverbs partly the same and by the further fact that some are not written from his standpoint, especially the utterances concerning the king. While it is not unlikely that Solomon uttered some of these proverbs, it is difficult to be certain of his authorship in any specific case. It is improbable that Solomon wrote any proverbs in the form now existent: 1 Kings iv, 32, does not mention Solomon as *writing* proverbs, but as *speaking* them.

Literary Characteristics.— The Hebrew word for proverb (mashal) probably meant originally a *comparison* and then was broadened to apply to any sententious saying, because often containing a comparison. The proverbs of this book do not bear in general the stamp of long popular use, but rather of the reflection of individuals. The whole book is written in what is called, from the Hebrew standpoint, poetry; for the most part gnomic, although the lyric form is also found, especially in chapters i–ix. Like Hebrew poetry generally, parallelism of the members of a verse is the most prominent characteristic. Antithesis is found especially in chapters x–xv. Each verse expresses usually an independent thought, except in chapters i–ix and chapters xxx–xxxi, where connected discourse is found. Brevity and sententiousness of statement are implied in the very nature of a proverb, while simile, metaphor and paradox are common. An extended personification of wisdom is found in the eighth chapter.

Purpose.— Although Proverbs has several authors and compilers, and much of it is disconnected in form, yet a marked degree of unity pervades the whole. The book confirms the statement of purpose in chapter i, 1–6, that is intended to teach wisdom to men, especially to the young and inexperienced, but also to those who already have some knowledge of wisdom. Wisdom, however, is a comprehensive term, it includes all that is desirable in character, folly all that is undesirable. Its foundation is religious, it consists fundamentally in a right relation to God, «the fear of Jehovah is the beginning of wisdom» (chapter ix, 10). But all that pertains to humanity is included in the scope of wisdom, so that the book touches all phases of human life. Observation of the customs and habits of men, and conclusions therefrom, have a prominent place.

Relation to Philosophy.— Wisdom is thus practical rather than speculative. To speak of the book as philosophical, as some have done, is, therefore, misleading. The book, it is true, identifies virtue with knowledge. But this is done, not from a philosophical standpoint, but from a religious and practical one. For the practical purpose of the writers, men are divided into two classes, those who know the right and do it, and those who are ignorant of it and do not do it. The other class, always so common, consisting of those who know the truth and do it not, is simply ignored. The speculative element is wanting in the book. The teachings concerning wisdom often suggest philosophical speculations concerning the greatest good, but they are always religious, not philosophical. Some of the proverbs may reflect a general acquaintance with Greek philosophy, but not definitely with the doctrines of any specific school.

Ethical Teaching.—The ethical teaching of the book is on a high plane. Ceremonial is occasionally alluded to, but the sages agree with the prophets that the external act has no value without an inner reality. When revenge is forbidden, chapter xx, 22, and chapter xxiv, 29, and kind treatment of enemies is enjoined, chapter xxv, 21, the standard approaches closely to that of the New Testament.

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PROVIDENCE, R. I., the county-seat of the county of the same name and the capital and largest city of the State, is situated at the head of Providence River, a tidal arm of Narragansett Bay. It is 30 miles north from the open ocean, about 20 west from Fall River, 40 southwest of Boston and 188 northeast of New York. It is the Atlantic terminal of the Grand Trunk Railway system and is also served by the New York, New Haven and Hartford Railroad, and by several coast lines of steamships and by one transoceanic line. It covers an area of 18.29 square miles. The early settlement was on the river at the mouth of two small streams, and for nearly 200 years it grew in an easterly direction, many of its finest residences being erected on the high hill overlooking the Providence River, this hill or ridge about 200 feet high dividing the valley of the two streams from that of the Blackstone or Seekonk, a river of some size. Later on the settlements began to extend in a westerly direction over low and rolling ground, and to-day the West Side, as it is called, is the most densely populated section of the city; though within the past few years a movement has again set in toward the east, a large area having been built up in that part of the city adjacent to and running west from the Seekonk. Situated near the sea the city has a rather humid climate with a considerable range of temperature, but the weather is neither as hot in summer nor as cold in winter as in places farther inland. The suburban seashore resorts are famous, and in the inland surrounding scenery is no less attractive to thousands of annual summer visitors. The prevailing winds in summer are from the southwest and in winter from the northeast or northwest. The city is more healthful than many large manufacturing cities and has been noticeably free from epidemics of serious diseases. The death rate is 14.71 per 1,000 and the birth rate 23.43 per 1,000. The centre of the city is given over to the business district. There are 253.21 miles of streets, curbed, graded and paved. There are 47 city parks with a combined area of 650 acres, the chief of which is Roger Williams Park. The chief monuments are those of Roger Williams, Thomas A. Doyle, for many year mayor of the city, the Soldiers and Sailors' monument and that of Gen. Ambrose E. Burnside. Providence possesses a civic centre which rivals anything of the kind in America. The principal buildings are the city hall, State house, State Normal School, public library, Roman Catholic cathedral, Rhode Island School of Design, buildings of Brown University, Providence College, Roman Catholic, and the State armory. Among its charitable institutions are the Rhode Island Hospital, Rhode Island Homœopathic Hospital Butler Hospital for the Insane, Saint Joseph's Hospital, Dexter Asylum and the State Institute for the Deaf. There are 160,000 volumes in the public library, while there are also the Law Library, that of the Providence Athenæum, the Rhode Island Historical Society and the Rhode Island Medical Society.

Commerce and Manufactures.— In 1681 Providence was the most compact settlement of the colony of which it was a recognized centre; but its commercial growth for the ensuing hundred years was not as rapid as that of Newport, which on account of its geographical position was better adapted for the maritime trade of the East Indies, China and the western coast of Africa. Providence, however, eventually became considerable of a seaport town, and for many years the wealth of the city was mainly derived from its commerce of the seas. With the growth in size of the freighters of the coastwise and trans-Atlantic trade and a proportionate lack of increased facilities for accommodating these larger vessels, Providence began about 1840 to lose its prestige in the shipping world, until finally its foreign maritime trade entirely disappeared. It can hardly look for its return, until the city, State or private owners of water front privileges provide suitable accommodations for the handling of that trade, which by reason of the natural advantages of a magnificent habor, easily entered, it should enjoy. It has a city quay 3,000 feet long, and State Pier No. 1, equipped to handle trans-Atlantic freight and passengers. Chief among the advantages of Providence as a centre of industry, commerce and trade are those pertaining to its geographical position, it being the natural outlet of southern New England, and the sources of supply and distribution which are the natural outcome thereof. For this reason it is designated as the southern gateway of New England. Though its reputation as a shipping port has gone, to-day Providence is one of the great industrial centres of the United States, noted for the variety of its manufactured products, the greatness of its industries, the skilled workmanship of its artisans and for the invention of those numberless ingenious accessories of modern life which have become necessities in this age of luxury. Pre-eminent among the varied industries of the city is the manufacture of jewelry with its allied interests, such as chasers, electroplaters, gilders, engravers, colorers, enamelers, die-sinkers, etc., approximating a total of over 1,000 establishments, engaged in a manufacturing industry whose products are distributed alike among the civilized and uncivilized nations of the earth. Providence is the first city in the country in the manufacture of many things, including jewelry and silverware, these producing $35,000,000 worth of goods annually and employing 12,000 people. Providence has the largest mechanical tool factory, file factory, engine factory, screw factory and silverware factory in the world, and almost a dozen other establishments deserving of similar distinction. According to the recent census it had 1,080 large manufactories, employing 46,349 operatives with an annual production worth $120,380,000. Besides there were from 1,500 to 2,000 smaller industrial establishments. In addition to the metal-working establishments there are textile mills, with an annual output valued at $523,000,000, dye-works, packing houses, rubber and elastic works and other establishments. The city ranks tenth among the seaports of the United States in bulk of tonnage and value of cargoes. The general coastwise trade is very extensive. It is the leading oil port of New England. There are 18 banks with combined capital, surplus and undivided profits of $27,607,322. The assets of national and State banks and trust companies amount to $203,063,356; savings banks, $57,659,673, making a total of $260,723,029. Individual deposits amount to $218,554,406, to which must be added $3,964,552 deposited in loan associations. The assessed valuation in June 1917 was $388,715,600, including real estate $231,838,840; tangible personal property, $64,651,900; intangible property, $92,194,860. The city's annual budget exceeds $7,000,000. Its gross debt amounts to $24,276,830.28; net debt, $15,014,646.56, including water bonds of $2,069,856.44. The net debt per capita is $58.87. The tax-rate is $18.50 per $1,000 on real estate and tangible personal property and $4 per $100 on intangible personal property. About $600,000 is expended annually on the fire department and about the same amount on the police department. There are 418.18 miles of low-pressure water-pipes laid in the city streets and 12.46 miles of high-pressure fire service pipes in the central district. There is also an excellent sewerage system.

The educational facilities include five high schools, 17 grammar, 17 primary, five for individual work, 10 ungraded for backward children, five open air, 12 evening, 28 training schools, 38 kindergartens, with 1,010 teachers and 212 evening teachers. The cost of maintenance is about $1,600,000 annually. The attendance in public schools is 34,814, and in 13 parochial schools 6,156 and 599 in 12 private schools. The evening school enrolment is 6,538.

History.— Providence was founded by that great apostle of religious liberty for the New World, Roger Williams, who arrived from England in Massachusetts Bay Colony in February 1631. He was well received by the Puritans as a «godly minister» but because of his boldness in announcing his views regarding the power of magistrates in religious matters he was forced to seek refuge with the Pilgrims at Plymouth. Subsequently he went to Salem, where his convictions regarding religious freedom incurred the displeasure of the General Court, and in January 1636 he was ordered to return to England; he refused and fled into the wilderness. Accompanied by five other men from Salem he had no fixed abode for weeks, but in June 1636 he began a settlement at a point north of the present site of Saint John's Church in Providence. Williams obtained a grant to lands covering what is now part of Rhode Island west of Narragansett Bay, from the Indians, the earliest deed on record being a memorandum dated 24 March 1637. In 1640 articles of agreement were adopted by the settlers as the basis of the town government, all affairs being regulated by a monthly town meeting. A royal charter was obtained in 1644 uniting various settlements about the bay, as «Providence Plantations in the Narragansett Bay in New England.» Providence being on the mainland and more exposed to the attacks of Indians, grew less rapidly than Newport on the island of Rhode Island, and in 1676 was nearly deserted. Less favorably situated for shipping than Newport, Providence grew but slowly; in 1730 the population of Providence, which included four settlements, was 3,916. In 1750 the population of Newport was twice that of Providence, and 1774 the population of the town of Providence proper was but 4,321, though by this time the population of Providence County was greater than that of Newport County. The first notice of a schoolhouse in the town records appears in 1752. A charter for a college was granted in 1764, and Providence County raising the most money, the first building was erected at Providence in 1770. This was the beginning of Brown University. Providence was one of the first towns in America to have a public library, a set of books having been bought by subscription before 1754 by a company formed for that purpose. During the whole of the 18th century Providence was a quiet community, where people lived simply with few amusements. The first theatrical performance was given by an English company in 1762. The first fire engine was purchased about 1755. The first advertisement of a regular stage line to Boston appears 1767; the stage made weekly trips. The first public market-house was erected in 1773. In the disputes with England that preceded the outbreak of the Revolution Providence took a considerable part. The first overt act of resistance to England was the destruction of the armed schooner *Gaspee* in 1772. During the Revolution Newport was occupied by the British from 1776 to 1779, and the commerce of Providence was almost cut off by the British fleet, though a number of privateers hailing from Providence preyed on English commerce. After the Revolution commerce slowly moved again, trade being with Europe, China and Central and South American ports. In 1801 a fire destroyed property valued at $300,000, and in 1815 a great gale wrecked many vessels and did damage to the amount of $1,000,000. From this time on the growth of Providence was steady if not rapid, the population about doubling every 20 years. Government by town meeting proving inadequate to meet the public needs, a city charter was adopted in 1831. The history of Providence during the 19th century is largely that of the industrial progress of the nation. The government is vested in a mayor and bicameral council. The latter elects several of the administrative officers. Connected with the suburban but separate municipalities of Cranston, Pawtucket, Warwick and East Providence, there is in a comparatively small area an aggregate civic population of over half a million, to which the city of Providence contributes 263,218.

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PROVIDENCE, *in theology,* the supervision exercised by God over his creatures and the universe; the doctrine being that divine power is possessed and exercised in every smallest detail of life. The doctrine differs from omnipotence, which does not insist that the power possessed by the Deity is exercised; and from naturalism, which holds that the universe is governed by natural laws with which God does not interfere. Religion and mythology agree, from their earliest records, in placing the affairs of men under the guidance of divine power.

PROVIDENCE, Sisters of, a religious order of the Roman Catholic Church, founded in France, according to some accounts in 1806, to others in 1820 (Sœurs de la Charité de la Providence), by Pastor Dujarie in the parish of Ruillé, diocese of Le Mans (department of Sarthe). It gradually extended beyond this parish, and was authorized in 1826. The final approval of the rules and constitution was given by the Holy See in 1887. A colony from Ruillé opened the first institute of the order in the United States on 22 Oct. 1840 at Saint Mary's, near Terre Haute, Vigo County, Ind. Establishments are conducted by the order in the archdioceses of Baltimore, Boston and Chicago and in the dioceses of Fort Wayne, Rockford, Indianapolis and Peoria. In 1918 the order had charge of 74 parochial schools, 32 academies for higher education, one industrial school, one college and two orphan asylums, with a total of 25,841 pupils. The mother-house is located at Saint Mary-of-the-Woods, Vigo County, Ind., formerly the centre for 1,332 sisters. Another mother-house is located at Brightside, Holyoke, Mass., with 345 sisters, 20 novices and 10 postulants, conducting orphan asylums, homes for aged men and women, hospitals and working girls' homes in the diocese of Springfield, Mass.

PROVIDENCE PLANTATIONS. See RHODE ISLAND, *History*.

PROVINCE is a territory, section or district of a nation or government. Among the Romans a province was a district of conquered country, governed by a proconsul or proprætor. The first Roman province was Sicily, 241 B.C. From the time of Augustus they were divided into the senatorial provinces and the imperial provinces. The latter comprised those which were most exposed to hostile inroads, and the administration of which was left entirely to the emperor under the pretense of sparing the Senate and people the trouble of managing them, but in reality to keep the army in his own hands. Under the empire the provinces were much better governed than they had been under the republic. One reason of this was that the emperors were more disposed to pay regard to the complaints of the provinces than the republican courts had been, for the latter were largely composed of men who had themselves profited, or who hoped to profit, by the same kind of maladministration with which the governors were charged, and were, therefore, always willing if possible to connive at such offenses. In addition to this the provincial governors under the empire received fixed salaries, which lessened the temptation to resort to illegal exactions to indemnify themselves for the expenses that they necessarily incurred in soliciting the office that was an indispensable condition of their governorship.

In modern times the term has been applied to colonies or to dependent countries at a distance, or to the different divisions of a kingdom itself. The name has sometimes been retained by independent states. Thus, the republic of Holland, after it had thrown off the Spanish yoke, was called the United Provinces; and the Argentine Republic used to be called the United Provinces of La Plata. In the canon law the term is applied to the jurisdiction of an archbishop. In the Roman Catholic Church it is also given to the territorial divisions of an ecclesiastical order such as the Franciscans, as well as to those of the Propaganda. For exhaustive accounts of the Roman provinces and their administration consult Arnold, W. T., 'Roman Provincial Administration' (1879); Mommsen, 'Roman Provinces under the Empire' (1884), and Taylor, T. M., 'Constitutional and Political History of Rome' (1899).

PROVINCE HOUSE, a brick mansion in Washington street, opposite the head of Milk street, Boston, Mass. It was built in 1679 for Peter Sargeant, a rich merchant, who used it as a dwelling. In 1716 it was purchased by the provincial legislature. From then on it was the residence of the colonial governors. After the Revolution it housed some of the officers of the Commonwealth. In 1811 it was given by the State to the newly incorporated Massachusetts General Hospital as part of its endowment. The trustees of this institution leased it in 1817 to a tenant who converted it to the uses of business. It finally became a tavern, a negro minstrel hall, and in October 1864 was destroyed by fire, only the walls remaining standing. Nathaniel Hawthorne used it as the setting for his 'Legends of the Province House' (1838–39) which were later reprinted in 'Twice-told Tales.' Consult Drake, S. A., 'Old Landmarks and Historic Personages of Boston' (Boston 1876); Hawthorne, N., 'Twice-told Tales' (edited with notes by J. H. Scott, in *Riverside Literature Series*, Boston 1907).

PROVINCETOWN, Mass., town, Barnstable County, at the extremity of Cape Cod, and on the New York, New Haven and Hartford Railroad. The earliest visitor to this place of which there is any record was Bartholomew Gosnold, 15 May 1602; it was visited by Capt. John Smith on his voyage to Virginia in 1614, and on 11 November (O. S.) the *Mayflower* anchored in the harbor and remained one month before going to Plymouth, and here the compact for their own government, said to be the first form of constitutional government in history, was prepared and signed; here Perigrine White, the first English child born in New England, first saw light, and here Dorothy Bradford, wife of the governor, was drowned. In commemoration of this visit, the United States government, in conjunction with the Commonwealth of Massachusetts and the Pilgrim Memorial Association of Provincetown, erected an imposing granite monument, 254 feet high, on Town Hill in the centre of the town, at a cost of $100,000, which was dedicated by President Taft on 5 Aug. 1910. The town remained a precinct for many years, and was incorporated as a town in 1727. The principal industry of the people is fishing, and in June 1915 a fleet of 75 vessels of all kinds were engaged in this industry. There are six large cold storage plants for fish freezing with a capacity of 80,000 barrels, a board of trade, one national bank, one savings bank, four Protestant and one Catholic churches, a public library, four private art schools, a high school and an art association. In recent years it has become popular as a summer resort. Pop. 4,370.

PROVINCIAL LETTERS ('Lettres provinciales'), by Pascal, or Provincial Letters, as they are usually called, though they are more accurately letters purported to be written to a friend in the provinces, mark an important stage in the great quarrel between the Jesuits and the Jansenists. These two parties were struggling in the 17th century for the religious, moral and intellectual control of France. As the Jesuits painted religion alluring and the Jansenists made it out almost oppressive in its austere majesty, the two sects were diametrically at variance. Arnauld, the great Jansenist theologian and friend of Pascal, was a leader in the controversy. In 1655 he was involved in a religious dispute, and his views were in January 1656 condemned by the Sorbonne or theological faculty. Arnauld, realizing that his own involved controversial writings could not appeal to the ordinary man, sought the help of Pascal, who brought out the first 'Provinciale' on 23 Jan. 1656. They lasted until March 1657. Pascal wrote 18 letters, began a 19th and had planned a 20th. They are supposed to tell a friend in the provinces what is happening in Paris between the Jesuits and the Jansenists. Pascal attacks both the dogma and the morals of the Jesuits. He argues the logically consistent Augustinian determinism, carried even beyond the doctrines of Saint Augustine, which was at the bottom of the teachings of Jansenists. He aimed to show the inconsistency of the Pelagians or semi-Pelagians, as he called the Jesuits, in trying to reconcile doctrines of God's foreknowledge and of salvation imparted by grace with man's liberty to accept or reject what is offered to his choice. But Pascal's most effective assaults were made against the morals of the Jesuits as Molinists or followers of the casuist Molina. The Jansenists were rigid, unbending moralists, unwilling to compromise in the slightest degree in word or in deed, even for the sake of a greater good. The Jesuits desirous of making converts had not invented but developed doctrines of casuistry, or the study of cases of conscience, by which in certain contingencies allowance could be made for deviation from the path of rectitude. Pascal made the most of his opportunities to attack the Jesuits' excuses for «equivocation» and «mental restrictions,» and charged them with teaching hypocrisy, unchastity and other sins.

The Letters form one of the most important examples of pamphlet literature in history. They deal, of course, with conditions and events now largely forgotten, but they were of extraordinary importance in their day and contributed greatly to the permanent discrediting with so many people of the Jesuit order. They are undoubtedly often unfair in their sarcasm and dialectical victories, perhaps sometimes even in statements of facts, but their vividness and lucidity make them a monument in French literature and one of the chief examples of early classical French prose.

Bibliography.— Important editions of the 'Lettres provinciales' are by Feugère (2 vols., 1887–95), and in the edition of Pascal's works, edited by Brunschvicg, Boutroux and Gazier and published in the series of 'Grands Ecrivains de la France.'

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PROVING GROUND, a space provided for testing ordnance and making ballistic experiments. The United States army's proving ground is at Sandy Hook, N. J. The navy has its proving ground on the Potomac River at Indian Head, Md.

PROVO (prō'vō) **CITY,** Utah, county-seat of Utah County, on the Provo River, and on the San Pedro, Los Angeles and Salt Lake, the Rio Grande Western and the Salt Lake and Utah Electric railroads, about 45 miles south of Salt Lake City. It was settled in 1849, and in 1851 was chartered as a city. It is in a region in which the principal occupations are agriculture, stock-raising and cultivation of fruit. The chief manufactures are flour, lumber, tin and iron roofing, woolen goods and canned fruit. There is a large trade in farm products, livestock, fruit, lumber and in the importing of groceries and textiles. The place is visited by many tourists on account of the Provo Cañon, Utah Lake and Bridal Veil Falls in the vicinity. It has the State insane asylum and a Mormon tabernacle. It is the seat of the Brigham Young University (Mormon). Pop. 10,000.

PROVOOST, prō-vō', **Samuel,** American Protestant Episcopal bishop: b. New York, 26 Feb. 1742; d. there, 6 Sept. 1815. He was graduated at King's College (now Columbia) in 1758, at its first commencement; went to England in 1761 to prepare for ordination, studied at Saint Peter's College, Cambridge University, and was ordained deacon and priest in 1766. Returning to America he became assistant rector of Trinity Church, New York. He resigned in 1771. In 1784 he was elected rector of Trinity Church. In the same year he was appointed a regent of the University of New York and was given the degree of D.D. by the University of Pennsylvania. Throughout the Revolution he took a firm stand in favor of the liberty of the colonies, and was chaplain to Congress in 1785 as well as to the United States Senate in 1789. In 1787 he was appointed a trustee of Columbia College. After presiding at the general convention held in Wilmington in 1786 (the absent Seabury being the only bishop in America), he set sail for England in company with William White to receive episcopal consecration, having been elected as bishop of New York. A special act of Parliament having been passed empowering the archbishops of Canterbury and York «to consecrate to the office of a bishop persons being subjects or citizens of countries out of His Majesty's dominions,» Provoost and White were consecrated by these prelates and the bishops of Bath and Wells and Peterborough in the chapel of Lambeth Palace, 4 Feb. 1787. Bishop Provoost resigned the rectorship of Trinity Church in 1800 and his see in 1801, but the House of Bishops declined to receive his resignation, giving consent, however, to the consecration of Dr. Benjamin Moore as assistant bishop. He is buried in Trinity churchyard. Consult Berrian, W., 'An Historical Sketch of Trinity Church' (New York 1847); Dix, M., ed., 'A History of the Parish of Trinity Church, New York' (4 vols., New York 1898–1906); Francis, J. W., 'Old New York' (New York 1858); Gallagher, M., 'Chapter of Unwritten History' (New York 1888); Hartley, I. S., 'Rt. Rev. S. Provoost' (in *Magazine of American History,* Vol. XXVI, p. 115, New York 1891); Perry, W. S., 'Bishop Seabury and Bishop Provoost' (1862); 'Provoost, A. J., ‘Biographical and Genealogical Notes of the Provoost Family’ (New York 1895); Purple, E. R., ‘Genealogical Notes on the Provoost Family’ (New York 1875); Schroeder, T. F., ‘Memorial of Bishop Hobart’ (New York 1831); Wilson, J. G., ed., ‘Centennial History of the P. E. Church in the Diocese of New York, 1785–1885’ (New York 1886); id., ‘Samuel Provoost, First Bishop of New York’ (in *New York Genealogical and Biographical Record,* Vol. XVIII, p. 1, New York 1887).

PROVOST, one who is set over others; one who is appointed to superintend or preside over something; the principal, head or chief of certain establishments or bodies; applied to (1) a jailer; the keeper of a prison; (2) the head of the faculty or principal of several colleges in the English universities of Oxford and Cambridge; the principal of the University of Dublin. In the case of a few colleges in the United States (e.g., University of Pennsylvania) the term is used in the same sense; (3) in Scottish cities the mayor is called provost, and in Aberdeen, Dundee, Edinburgh and Glasgow «lord provost»; (4) in ecclesiastics it is sometimes used in the same sense as prior, or to designate the head of a chapter, corresponding to the more frequent term «dean»; in the German Lutheran State Church is applied to the pastor of the principal church in a district; (5) in France the judge of certain royal and feudal courts.

PROVOST-MARSHAL, in military affairs, an officer who takes cognizance of offenses against discipline, orders the arrest and the punishment of deserters and other offenders according to the sentence of a court-martial, and maintains order generally. In the British army the provost-marshal has the rank of captain, and superintends the preservation of order, and is really the head of the military police of a camp or military district. In the United States army there is a provost-marshal-general who supervises the work of the several divisions, and to this was added in 1917–18 the charge of the operation of the Selective Service (Conscription) Laws, and the multitudinous duties incident thereto. See COURT-MARTIAL; MILITARY LAW.

PROXY, person who is empowered, or the instrument by which a person is empowered, to act or vote for another, most frequently used in the case of public assemblies, conventions, boards of directors, meetings of shareholders, etc. In Great Britain every member of the House of Lords was formerly permitted, on obtaining a nominal license from the Crown, to appoint another lord of Parliament his proxy to vote for him in his absence. Only a spiritual lord could be proxy for a spiritual lord, and a temporal for a temporal lord, and no peer could hold more than two proxies at the same time. Proxies were never used in judicial business or in committees of the House, nor could a proxy sign a protest. The practice of admitting proxies was discontinued in 1867.

PRUDDEN, prŭd'ĕn, **Theophil Mitchell,** American physician and author: b. Middlebury, Conn., 7 July 1849. He was graduated from the Sheffield Scientific School, Yale, in 1872; from the Yale Medical School in 1875 and received the degree of LL.D from Yale in 1897. Besides contributing to the scientific literature of pathology and of bacteria and their influence in disease, he has written on these and other scientific topics for the general public. He is emeritus professor of pathology in the College of Physicians and Surgeons, Columbia University, New York. Among his writings are ‘Handbook of Pathological Anatomy and Histology’ (10th ed., 1914), with F. Delafield; ‘Story of the Bacteria’ (1899); ‘Dust and its Dangers’; ‘Water and Ice Supplies’ (1891); ‘On the Great American Plateau’ (1907).

PRUDENTIUS, proo-dĕn'shĭ-ŭs, **Aurelius Publius Clemens,** Christian hymn writer: b. Spain, probably at Saragossa, 348; d. about 410. He practised the profession of an advocate and afterward became a functionary of the government. From a life of pleasure and worldliness he was reclaimed by his conversion to Christianity, retired to a cloister in his 57th year and there spent the remainder of his life. It was during these latter years that he wrote the religious poems which have made his reputation as the greatest Christian poet of the 4th and 5th centuries in the Latin Church. This was the golden age of Latin patristic letters and his contemporaries included Ambrose, Jerome and Augustine. It is quite evident that he was a profound student of classic latinity, for he shows a complete mastery of the epic and lyric metres of Roman literature, and at the same time these poetical works are purely Christian, full of devotional feeling and theological lore. His ‘Liber Cathemerinon’ consists of 12 religious poems for daily use; while ‘Psychomachia’ is an allegorical description of the struggle between good and evil in the human soul. ‘Peri Stephanon’ is a metrical martyrology. Other works by him are ‘Apotheosis’; ‘Hamartigenia’; ‘Contra Symmachum’; and ‘Dittochæon,’ the first three being polemic, the last chiefly of archæologic interest. There are many manuscripts of Prudentius' works; the best of these is considered to be that in the Bibliothèque Nationale, Paris (Latin Department, 8084), dating from the early 6th century. There are also a great number of editions of his writings. Amongst these should be mentioned Giselin (Antwerp 1564); Arevalo (Rome 1788), the latter reprinted in Migne, J. P., ed., ‘Patrologia Latina’ (Vols. LIX–LX, Paris 1847); Obbarins (Tübingen 1845); Dressel (Leipzig 1886). A still more recent critical edition has been undertaken by J. Bergman and is still uncompleted. There are a number of English translations of some of his works amongst which should be mentioned Anon., ‘Psychomachia; the War of the Soul: or the Battle of the Virtues and Vices’ (London 1743); Anon., ‘The Cathemerinon and other Poems in English Verse’ (London 1845); Pinder, N., ed., ‘Selections from the Less Known Latin Poets’ (Cambridge 1866); Morrison, G., translator, ‘Hymns, etc.’ (London and Cambridge 1887–91); Thackeray, F. St. J., ‘Translations from Prudentius’ (London 1890); Pope, R. M., and Davis, R. F., translators, ‘Cathemerinon’ (New York, n.d.). Consult Baumgartner, A., ‘Die Lateinische und Griechische Litteratur der Christlichen Völker’ (in ‘Geschichte der Weltlitteratur’ Vol. IV, Freiburg 1900); Bergman, J., ‘Lexicon Prudentianum’ (Upsala 1894); id., ‘De Codicum Prudentianorum’ (in *Kaiser-*

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PRUDHOMMES, Conseils de, kŏn-sā-ē dė prū-dŏm, courts of conciliation in France for deciding small disputes between workmen and employers. The first councils called by this name in Paris were formed in 1296 in the reign of Philippe le Bel, when 24 *prud'hommes* were appointed to assist the provost of the merchants in settling disputes between merchants and manufacturers at the fairs and markets. After the Revolution of 1848, at which period 75 towns had conseils de prud'hommes, the whole legislation on this subject was revised. All the patrons and workers of industrial establishments within the circle of jurisdiction of the council of prud'hommes were made eligible as electors. In June 1853 a law was passed which, with some modifications, is still in force. The patrons and the workmen are formed into separate electoral colleges, each to elect an equal number of prud'hommes. Qualifications for election are a minimum age of 30 years, ability to read and write and citizenship. The office used to be honorary, but compensation, varying locally, is now permitted by law. The general conseil, besides the president, vice-president and secretary, is composed of an equal number of patrons and workers, with a minimum membership of six. They are elected for six years, one-half of the membership being renewed every three years. The jurisdiction of the conseils is summary and without appeal for sums under 200 francs; above that sum an appeal lies to the tribunals of commerce. The presidents and vice-presidents of the conseils de prud'hommes are elected by the conseils for one year, one being a patron and the other a workman. The number of conseils de prud'hommes is now about 225. Consult Block, R., and Chaumel, H., 'Traité Théorique et Pratique des Conseils de Prud'hommes' (Paris 1912); Block, M., 'Dictionnaire de l'Administration Française' (Vol. II, Paris 1905); Cluzel, G., 'Traité Pratique des Conseils de Prud'hommes' (Paris 1908); Thomas, E., 'Les Conseils de Prud'hommes, leur Histoire, leur Organisation' (Paris 1888).

PRUDHON, Pierre Paul, pē-ār prū-dôṅ, French painter: b. Cluny, Saône-et-Loire, 4 April 1758; d. Paris, 16 Feb. 1823. He received his first instruction in his art at Dijon under Devosge. In 1780 he went to Paris. Two years later he won a competition for a Roman scholarship offered by the estates of Burgundy. He arrived in Rome early in 1785 and devoted himself assiduously to study, forming his style on that of the 16th century masters, especially Leonardo da Vinci and Correggio. He returned to Paris in 1789 and painted portraits, gaining with difficulty his living under the Terror. He gradually made himself known, although his misfortunes had been early aggravated by a marriage undertaken under circumstances of great imprudence; and in 1800 he became famous by his timely picture 'Truth Descending from Heaven.' In 1808 appeared in the Salon his 'Psyche Carried off by Zyphyrus' and 'Crime Pursued by Justice and Divine Vengeance,' the latter now in the Louvre. From this time his position was assured. In 1808 he received the Legion of Honor and in 1816 was made a member of the Institute. In these years he also found compensation for his unhappy marriage in the love and care of one of his pupils, Mlle. Constance Mayer. Besides paintings and mural decorations he also made many designs for elaborate furniture for the emperor and his family amongst which may be mentioned the cradle for the Prince of Rome, the son of Napoleon I and Marie Louise. He also etched many of his works and almost innumerable engravings of many of them were made by etchers of his own times and of later periods. His importance in the history of French art history lies in the fact that he indicated a revolt from the cold classicalism of David, introduced freer and bolder pictorial effects than had so far obtained in French art and utilized the emotional and sentimental resources which lie in the skilful distribution of light and shade in a picture. Other works of his are 'Cupid Chastised' (National Gallery, Dublin); 'The Assumption'; 'The Crucifixion'; 'Interview of Napoleon I and Francis II after Austerlitz' (Louvre, Paris); 'Union of Love and Friendship'; 'Venus and Adonis'; 'An Unhappy Family'; 'Venus in the Bath.' The last four works are in private collections, as are also many others, as well as most of his portraits and sketches. Seventeen of the latter, however, are to be found in the Louvre. Works of his may also be seen in museums at Angers, Cherbourg, Dijon, Montpellier, Orleans, Quimper, etc. A sketch of a ceiling in Dijon is owned by the Historical Society, New York. Consult Blanc,

C., ‘Histoire des Peintres’ (Vol. III, ‘Ecole Française,’ Paris 1865); Burty, P., ‘Un Carnet de P. P. Prud'hon’ (in *L'Art,* Vol. VII, p. 11, Paris 1876); Clément, C., ‘Prud'hon, sa Vie, ses Œuvres et sa Correspondance’ (Paris 1872); Delacroix, E., ‘Peintres et Sculpteurs Modernes’ (in *Revue des Deux Mondes,* n.s. Vol. XVI, p. 432, Paris 1846); Duplessis, G. V. A. G., ‘Les Œuvres de Prud'hon à l'Ecole des Beaux-Arts’ (Paris 1874); Forest, A., ‘P.-P. Prud'hon, 1758–1823’ (London 1913); Foster, J. J., ‘French Art from Watteau to Prud'hon’ (3 vols., London 1905–07); Ganthiez, P., ‘Prud'hon’ (in ‘Les Artistes Célèbres,’ Vol. XI, Paris 1886); Goncourt, E. de, ‘Catalogue Raisonné de l'Œuvre Peint, Dessiné et Gravé de P. P. Prud'hon’ (Paris 1876); id., and de Goncourt, J. A., ‘L'Art du 18e Siècle’ (Vol. II, Paris 1882); Gueullette, C., ‘Mlle. Constance Mayer et Prud'hon’ (Paris 1880); id., ‘Note et Renseignments Inédito sue Prud'hon et sa Famille’ (in *Gazette des Beaux-Arts,* Période II, Vol. XXXII, p. 149, Paris 1885); Jean, R., ‘Prud'hon dans la Haute Saône. 1794–96’ (in ibid., Periode III, Vol. XXXVIII, p. 273, Paris 1907); Quatremère de Quincy, A. C., ‘Notice Historique sur la Vie et les Ouvrages de P.-P. Prud'hon, Peintre’ (Paris 1824); Voïart, Mme. A. E. E., ‘Notice Historique sur la Vie et les Ouvrages de P.-P. Prud'hon, Peintre’ (Paris 1824).

PRUE AND I, a work by George William Curtis (q.v.), first published in 1856. It is a series of sketches or meditations showing the enjoyment to be derived from even the most commonplace existence. The papers are supposed to be written by an old bookkeeper, who strolls down the street at dinner-time and without envy watches the diners-out. But whatever the genial old bookkeeper is thinking or relating, his heart is full of Prue, and from beginning to end it is always «Prue and I.» Consult Cary, E., ‘George William Curtis’ (Boston 1894).

PRUNE, dried plums of certain varieties and the varieties used for drying. They are extensively cultivated in the Danubian principalities, France, Italy, and in recent years in California, Oregon and Washington, from which States the American market is now chiefly supplied. The product is of great commercial importance and nutritious qualities. Any variety of plum having the requisite percentage of sugar, plenty of solids and which, when cured, will keep for a long time without deterioration, is suitable for making prunes.

Prune growing was introduced into California in 1856, from scions imported from France, and in 1863 prunes were for the first time publicly exhibited as a California product. The first large orchard was planted in 1870, yet in 1915 nearly 100,000 acres of bearing and 30,000 of young trees were recorded. Attempts have been made to cultivate the prune in eastern parts of the United States, but without success, owing to the absence of requisite conditions for curing. Cultivation has been successfully extended to Australia and South America, and these countries will ultimately prove formidable competitors in the trade. In California where the wet and dry seasons are well defined, and from May until October rains are infrequent, never exceeding a fraction of an inch in volume, exist the best natural conditions for perfect curing of the prune. The fruit is not picked until perfectly ripe, then it is gathered from the ground whence it has fallen naturally from the trees when ripe. It is then passed through a sizer which separates the various sizes in order to secure uniformity in drying, as small fruit will dry in a shorter time than will a larger size. Next it is dipped into a weak solution of boiling lye to take off the bloom and facilitate curing. Sometimes the outer skin is punctured by needles to allow the surplus moisture in the fruit to escape readily. In large establishments endless-chain machines are employed in dipping, but where it is done by hand a wire dipper is used. The fruit is washed in fresh water after the process to clean off the lye. After spreading upon wire-netting trays, the fruit is taken to the field and exposed to the sun's heat until properly cured. The summer days in California are invariably hot and the raw fruit, after exposure to the sun's rays for 6 to 10 days, depending upon size, is thoroughly dried. (In eastern Europe it is customary to cook the fruit partly before exposing it to the sun). In countries where periods of dry weather are liable to be interrupted, evaporators are used in extracting the moisture of the fruit, the trays being introduced into a chamber in which the temperature is raised to 140° to 180°, and where they remain from 12 to 48 hours. To understand the exact amount of time necessary perfectly to cure the fruit is essential, as if this matter is ill-judged an inferior quality of product results. When sufficiently cured, the fruit is taken from the trays to bins, where it is allowed to «sweat» for two or three weeks, after which it is ready to be graded and packed for market. Grades are indicated by the number of prunes to the pound, according to the size; 30 to 40 to the pound represents the highest grade, 120 or 130, the smallest. Before final packing the prunes are «processed» by dipping into a hot solution of water with glycerine or fruit syrup, which not only adds to the beauty and polish of the fruit, but extirpates insect germs that may be present. Producers seldom introduce a substance in the process mixture for increasing weight. In shipping, sacks are employed when a buyer intends to pack for his own trade, but the larger quantity is packed into boxes of stated dimensions at the place of shipment. French methods are also practised in packing high grades in fancy boxes with attractive linings. In quantity the States of California, Oregon and Washington produce a larger amount than all foreign countries put together, the annual output of the three States aggregating about 210,000,000 pounds in 1912. Large quantities of the better sort of American fruit are exported to Europe, where they rank equally with the finest brands of France.

Orchards of large size are found in various parts of California. They require the same careful cultivation as plums and frequent pruning, besides occasional irrigation. The nomenclature of the prune-making plum is large and abounds in synonyms. The following varieties are most favored in America: Petite or Prune d'Agen, the most important in California; Italian (Fellenberg) in Oregon, with Tragedy perhaps second and Hungarian third. Other varieties grown commercially are Pacific, Willamette, Clairac, Mammoth, Columbia, Tennant, Silver and Sugar. Consult Bailey, 'Standard Cyclopedia of Horticulture,' titles 'Prune'; 'Plum'; 'California'; and 'Evaporation of Fruits' (New York 1914–17).

PRUNELLA, a kind of smooth woolen or mixed stuff of which clergymen's gowns were once made and which is still used for the uppers of ladies' boots and shoes.

PRUNING, the removal of parts of plants in order to economize and divert energy in desired directions. Fundamentally the various objects for which plants are pruned are (1) training, in which the limbs are started and disposed as desired; (2) pruning proper; (3) trimming or the shaping to some artificial form. The first is of prime importance in the early years of orchard fruits, but is of smaller and smaller application as the subjects dealt with are shorter-lived or less tree-like. The second is important, as a rule, during the whole life of the plant, in many cases, especially of trees, commencing when the plants are set. The third is usually of small importance, at least in America, being employed mainly with such ornamental subjects as hedges, topiary specimens and dwarf trees.

Popular opinion concerning the practice has changed within recent years. Formerly it was against pruning upon the ground that the plants suffered and that the practice was unnatural. But nature is an inexorable pruner, as the straight limbless trunks of forest trees and the dead twigs and branches of trees left to themselves sufficiently show. The horticulturist improves upon nature in doing his work intelligently, not only with respect to what shall be removed, and when, but how it can be best done, so as to enhance the healing of the wound. The practice is essential to successful orchard fruit culture and to a greater or less extent with other plants. With woody plants that have been grown in nurseries it is necessary to cut back the tops to approximate a balance between the top and roots which latter have been necessarily reduced in digging. The usual practice in this matter is to remove at least one-half of each branch that is to remain and to cut off all the others. Many orchardists trim off all the limbs and some leave nothing but a switch or even a stub, claiming that they can then form the head of the tree where they desire and that the tree more quickly recuperates than if a larger proportion of top is left. Certain it is that in practice the trees untrimmed at transplanting time generally suffer severely.

Among the principal objects sought in the pruning of fruit-trees the following may be mentioned: To divert plant-food from wood production into fruit formation and development of improved specimens; to keep, not to force, the tree in bearing condition, which is secured by regular annual attention and not by intermittent neglect and butchery; to prevent the excessive production of wood which is usually at the expense of fruit production and ordinarily is a sequence of excessive pruning; to keep the tree within manageable limits so as to facilitate cultivation, spraying and harvesting; and to admit light and air to the tops so that the fruit may be well colored.

Before any pruning is done, however, it is essential to know the exact manner in which the trees or shrubs bear their fruits, for unless this is understood the operator may be working against his own interests and injuring the tree at the same time. For instance, apples and pears bear their fruits upon gnarly twigs called spurs, the plum and cherry usually upon spurs, but sometimes also on the axial growths; the peach bears usually upon the axial growth of the previous season, but also to some extent upon spurs which live only two or three years as a rule; the quince bears upon terminal shoots of the present season; the grape upon shoots of the current season; the raspberry and blackberry usually upon shoots of the previous season, the shoots dying after production; and the currant and gooseberry upon wood one or more years old. Further advantage may be taken of the method of fruit production in preventing the necessity of thinning, the fruit-buds being removed by the cutting out of the fruit-bearing wood.

In the pruning of ornamental subjects the same principles apply. Except for removing straggling, unsightly or unnecessary growths, the pruning has mainly to do with flower production. Flowering shrubs and trees may be divided into two groups; those which produce their flowers from buds which were matured during the previous season; and those whose buds are developed during the current year. The one rule that will apply to these subjects is: Prune after flowering. If members of the first group are pruned during the winter they will generally suffer severe loss of flower buds; members of the other group, however, should be pruned, preferably, in early spring about the time that growth starts. Properly done and at the right time the production of bloom should be greatly enhanced with each group.

There is considerable difference of opinion as to when subjects should be pruned, but if wounds are properly made, that is, close to the main stem without leaving any stub, and if the large ones are protected from decay during the healing process, they may be pruned at any time, preferably, perhaps, just before the season of most active growth when the object is wood, and after this period if the object is fruit. Trees grown as cordons, espaliers, etc., require the greatest skill, but these practices are largely matters of training and are of rare application in the United States.

There is an immense literature on the subject, consisting chiefly of short articles on special phases, to be found in horticultural journals of this and foreign countries and in the publications of governmental departments of agriculture and of agricultural colleges and schools. For general treatment of the subject consult Bailey, L. H., 'The Pruning Manual' (New York 1916); Hood, G. W., 'Laboratory Manual of Horticulture' (Boston 1915); Kains, M. G., 'The Principles and Practice of Pruning' (New York 1917); Newsham, T. C., 'The Propagation and Pruning of Hardy Trees, etc.' (New York 1913); Udale, T., 'The Handy Book of Pruning, Grafting and Budding' (Evesham 1915).

PRUNUS, a genus of shrubs and small fruit trees of the rose family, about 75 of which are widely distributed, especially in the north temperate zone, and include many leading fruits of the world and many species of ornamental value. They have alternate leaves; solitary or clustered, pink or white flowers which appear usually in spring; and drupaceous fruits containing one hard-stoned seed. The number of varieties and hybrids is legion; they include weeping, double-flowered, variegated-leaved and diversely colored subjects, besides the host of varieties cultivated for their fruits. Their range of hardiness varies with the species, some being hardy in the cold North and Plains States, others tender even at the latitude of New York. The most important members of the genus or sometimes referred to it are treated under their own titles, as Almond; Apricot; Cherry; Nectarine; Peach; Plum; Prune; Sloe.

PRURITUS, itching, a symptom of various skin diseases. It may occur independently of any structural alteration of the skin, as a purely psychogenic affection and is then frequently a symbol of unconscious masturbation. It may involve the skin of the entire body or be limited to a particular region, such as the anus, scrotum or vulva. The sensation is described as prickling, burning or crawling. It is very annoying when slight and may be so severe as to destroy all sense of comfort. Excitement and overheating, even the warmth of the bed at night, cause at times troublesome exacerbations. The etiology of this affection is frequently obscure. Impaired general health and a neurotic tendency are predisposing causes. Pruritus senilis is a distressing form occurring in advanced age and is due to degeneration of the skin. Pruritus hiemalis (winter itch) is peculiar to cold weather. Other causes are the change from light to heavy under-clothing; ingestion of certain drugs, as opium; sometimes hepatic and renal disease; and the circulation in the blood of abnormal biliary constituents, as in jaundice, and of other abnormal material in diabetes. Localized pruritus frequently depends upon a venous congestion of the part; thus pruritus ani is invariably aggravated by constipation and obstruction of the portal circulation; and in pruritus vulvæ, uterine engorgement and pregnancy are exciting causes. Worms not infrequently produce itching of the anus and of the nose, the latter being a reflex condition. The almost constant scratching caused by a persistent localized pruritus is likely to produce eczema.

In treatment the general health is to be improved by hygienic measures; sometimes an entire change of diet, scene, etc., is necessary. Internal medication should be left to the physician. A psychoanalysis is necessary to cure certain cases. Local remedies are palliative, only relieving the discomfort until the cause of the itching is removed. Among the palliatives are carbolic acid, borax, soda, starch, chloroform in powder, liniments, solutions and ointments.

PRUSSIA (German, Preussen; Latin, Borussia), a kingdom of Germany, and its largest, most populous and most important state, comprising nearly two-thirds of its area. The boundaries of Prussia are on the east, Russia; on the south, Austria, Saxony, Bavaria, Hesse-Darmstadt and the Thuringian states; on the north, the Baltic, Denmark, Mecklenburg and the North Sea; on the west, Belgium and the Netherlands, Alsace-Lorraine and Luxemburg. The circumference of Prussia measures 4,762 miles and except for some small enclaves, including the Hohenzollern principality, which is surrounded by Württemberg territory, Prussia is a compact mass of land, taking up nearly the whole of northern and eastern Germany. In shape it is, roughly, an elongated oval. Its greatest length, from Memel to the borders of Alsace-Lorraine, is about 800 miles, and its greatest width something over 400. The frontiers of Prussia, however, are political rather than natural. The area is 134,622 square miles. The heart of it is the province of Brandenburg, from which small core the kingdom of to-day has grown by conquest or otherwise. Prussian territory encloses, wholly or nearly so, the small German states of the two Mecklenburgs, Anhalt, Brunswick, Oldenburg, as well as the old Hansa republics of Hamburg, Bremen and Lübeck. Prussia holds some five-eighths of the population of Germany. The density of population by the square mile, in 1910, the last census year, was 292.80.

Topography.— Three-fifths of Prussia form part of the great northern European lowlands. This plain is much wider in the east, only the southern border of Prussia being there mountainous, than it is in the west. Roughly, an imaginary line run from about Bonn to Wittenberg would separate the lowlands from the highlands of Prussia. The Sudetian range divides Prussia from Bohemia and Austria, and its highest peak, the Schneckoppe, lies on Prussian soil. The Harz range runs nearly parallel with the Sudetes and might be considered a continuation of them. South of the Harz the Prussian boundary cuts the Thgringian Forest, and this again is prolonged by the Weser range of hills and the Teutaburg Forest. In the southwest the lower Rhine region includes the Hunsrück and Eifel, the Taunus, Westerwald, Siebengebirge, Spessart and Sauerland, nearly all of it on Prussian territory. Again the Rhön mountains, the Vogelsberg and other small ranges interpose themselves between the Rhenish and Thuringtian system. North of the Sauerland, in the region of the Ruhr River, are situated the most important coal-bearing lands of Prussia, while the extensive, but on the whole not so valuable, coalfields are in eastern and northern Silesia. Prussia has an ocean front («Waterkant») of some 1,100 miles on the North Sea and the Baltic, being nearly the whole seashore that Germany can boast of. Tidal variations are not very great on the North Sea, and still less so on the Baltic, but fierce and frequently recurring northwest storms have caused great devastation along the rather flat seaboard of Prussia, so that during historical times alone thousands of square miles of coast have been swallowed up in the ocean. The Frisian chain of small islands (including Heligoland) are the remnants of a former coast line, and dikes and other costly means of preservation have to be kept in constant repair against the renewed inroads of the sea. Much of the coast land being marshy soil, it serves for pasturage only. The Baltic is much more shallow than the German Ocean and is not distinguished by well-defined ebb and flood, and its coasts are mostly sandy and infertile dunes. The only island along the Prussian line of the

Baltic that deserves mention is Rügen, a fertile tract of great scenic beauty. However, the Baltic coast has several deep indentations, such as those near Lübeck, Danzig, Kiel and the Pomeranian bight. The so-called Haffs are semi-inland bodies of water but slightly brackish and formed by the waters of the rivers emptying themselves into hollows nearly cut off from the sea proper by dunes and small tongues of projecting mainland. Although Prussia is in its main part rather flat, so that no serious obstacles interfere with the railroad and canal systems, that does not mean that the land is quite level. Indeed, hills and rocks rising to a height of 600 feet and more are of frequent occurrence on the long line between the mouth of the Ems River and the Russian border, these elevations dating from the Ice Age and being formed by accumulations of boulders and moraines.

Hydrography.— Prussia contains a large number of lakes, especially in her northeastern section, but none of them of great importance. There are also large swamps along the lower course of the Oder, Havel, Warthe and Netze rivers, and drainage work has been going on. All the river system of Prussia belongs to the basins of the Baltic and North Sea, the Danube, which empties into the Black Sea, being the only large river of Germany that does not figure in Prussia's national economy. All the other principal rivers of Germany, such as the Elbe, Rhine, Weser and Oder, with most of their tributaries, and the Vistula (Weichsel) and Niemen (Memel), coming from Polish or Russian soil, in their most navigable and important portions, form part of the Prussian river system. The Rhine flows through Prussian territory about 200 miles, the Weser and Oder almost completely and the Elbe for about two-thirds of its course. There are also a large number of shorter coast rivers, such as the Pregel, Leba, Wipper, Rega, Peene, Ucker, Trave, all belonging to the Baltic, and the Eider, Ems, Werra, Fulda, Saale, Havel and Aller of the North Sea range. Prussia has also a considerable number of artificial water courses. Of these the Baltic-North Sea Canal (officially styled the Kaiser Wilhelm Canal), the construction of which entailed an expenditure of about $36,000,000, is in most respects of highest importance. Vistula and Oder are connected by the Bromberg Canal; Oder and Spree by the Müllrose Canal; Havel and Elbe by the Plau Canal; Elbe and Trave by the Stecknitz Canal; Eider and Baltic by the Eider Canal. Of late years these canals have been increased in size and depth, and since the beginning of the great World War just past Prussia has planned, and is now as a matter of fact executing, a great and ambitious plan intending to connect all the principal Prussian rivers with the Danube and with each other, so as to form a great Danube shipping canal that is to make the Danube available for large boats from Regensburg to the Black Sea. It can, therefore, be said that in its hydropathic aspects, as far as variety, diversity of direction and number of means are concerned, Prussia is singularly fortunate and well supplied.

Climate and Soil.— The climate of Prussia is wholesome and temperate. It is the distance from the Atlantic rather than mere latitude that is the determining factor in its climatic variations. Thus the mean temperature of Königsberg (far to the northeast of Prussia) is 43° F.; that of Berlin but five degrees more, namely, 48° F.; at Aachen (Aix-la-Chapelle), on the western border, 49° F. and at Köln (Cologne) and Trier (Treves) 50° F. As one proceeds to more southerly latitudes, in Prussia, the higher altitudes even up differences. However, the greatest differences are between east and west, due to the prevailing northern and eastern winds from Prussia and the Scandinavian north in the eastern portions of Prussia. Extremes of temperature, therefore, are also greater in the eastern parts, wholly in the colder seasons. The average rainfall in Prussia is about 21 inches, being highest in some of the western provinces (31–34 inches) and lowest in the northeast portions (16 inches). The soil of Prussia, though in some of the western mountain regions (Rhön, Eifel, etc.) and in certain districts of the northeast very bleak and sterile and but of mediocre fertility in the northern central portion (Brandenburg), is on the whole fairly productive, and pre-eminently so in the bottom lands of the Rhine, Weser, Oder, Elbe, Unstrut, Warthe, Netze rivers. Even where in its natural state the soil is poor and meagre, much has been done by wise agriculture, assiduously fostered by the government, to improve its yield from year to year.

Geology and Mineral Resources.— Of the two widely differing geological formations of Prussia, the entire flat part of it, being the larger, is covered with clay and sand of the Quarternary Age, having been spread over the surface since the Ice Age till the present day by alluvial and glacial action. And these deposits rest upon all formations from the Primary down to and through the various phases of the Tertiary. Cropping out here and there the harder rocks often emerge above the Diluvian and Alluvian. This is the case in Rügen with its chalk cliffs, in the limestone plateau near Rüdersdorf, etc. The Rhenish and the Thuringian systems are part of the Triassic system of the upper Rhine. The Silesian ranges — Riesengebirge, Sudeten, etc.,— are mainly of gneiss and granite, while Harz and lower Rhine belong to the Devonian and Silurian formations. Prussia excels as a mining country, especially in coal, iron, lead, zinc, copper, potassium, leading by far the rest of Germany in mining products. About 89 per cent of Germany's coal supply comes from Prussia, mainly from the Ruhr Basin, Rhine province, Westphalia and Silesia, while soft coal and lignite comes from Saxony; peat also is obtained in big quantities from the northwestern lowlands near the coast. The last available statistics, those of 1912, show that Prussia mined 165,302,784 metric tons of hard coal and of lignite and soft coal 65,803,959 metric tons. Iron comes chiefly from the provinces of Silesia, Westphalia, Hesse-Nassau and Hanover, the yield being in pig iron in 1911 some 10,477,263 metric tons. The eastern portion of Silesia has practically a world monopoly in zinc, the figures for 1913 being 702,893 metric tons. Copper was mined in the same year in Prussia to the amount of 996,235 metric tons in ore, and of lead some 158,857 metric tons. In manganese production, too, Prussia is supreme. Of table salt Prussia is very prolific, and in potassium it is the chief source of production. Petroleum is obtained in limited output in the province of Hanover. The far northern coast of the Baltic yields an abundance of amber. A large proportion of mines and salines in Prussia are under government control and ownership. In 1913 there were employed in the mining industry in Prussia some 769,584 persons.

Agriculture.— Prussia is the chief agricultural state of Germany. Of the total area of Prussia 52.3 per cent consists of cultivated fields, orchards, vineyards and vegetable gardens; 17.5 of meadows and pastures; 22.7 of forests and woods, and 7.5 only of untilled or unproductive land. The number of agricultural holdings in 1911 was 3,256,044, the farm lands totaling 20,781,147 hectares (one hectare = 2.471 acres). Of these by far the larger proportion was in small farms of less than 20 hectares, owned by 3,103,151 parties and making up 41.2 per cent of the whole cultivated soil. Of large estates of 100 hectares and over the percentage is more considerable in Prussia than in the remainder of the empire, because of «East Elbian» political and economic conditions. In fact, in those provinces of Prussia where the landed gentry still keeps its traditional grip on the country and where thousands of them own estates each over 1,000 hectares agriculture is most backward and the soil yields, in proportion, the least per hectare. This is due to the system of tillage in vogue, the land being annually worked by so-called «wanderhände» (or season laborers) who come from the neighboring districts of Poland or Galicia, and who return thither after the crops are in. In a general way, however, although it cannot be denied that urban industry in Prussia, as elsewhere in Germany, has made large strides, somewhat at the expense of the former rural population, it must be conceded that the peasants, farmers and estate-holders, large and small, are in a fairly prosperous condition, attributable chiefly to intensive cultivation of the soil and to the fostering legislation of the government, as well as to the extensive use of agricultural machinery, much of it made available by the co-operative plan, to most progressive methods of tillage and to increasing diligence. The co-operative system in vogue, notably among the smaller farmers, enables them not alone to buy on shares or hire even the most improved types of farming machinery run by electricity, alcohol, petroleum, etc., for all the processes of farming, such as ploughing, drilling, harvesting, binding, threshing, grinding, etc., but also to dispose of their produce to best advantage, much of it without any middlemen, by directly dealing between producer and final consumer. Alcohol, used as a source of mechanical energy, is more extensively employed in Prussia than anywhere else in the world, and distilleries for the wholesale manufacture of methyl alcohol are very common, a cheap grade of potatoes being mostly used in the process. The soil of Prussia varies greatly in quality. Of the cultivable land there some 29 per cent is loam and clay, 32 per cent middling, namely, loam and sand mixed, 31 per cent is predominantly sandy and 6 per cent bogs and marshes. Besides the basin of the Rhine and its tributaries, that of the middle Elbe, Saale, Unstrut, etc., the extensive plain around Magdeburg, the so-called *Böhrde,* and some other large areas are most fertile. The chief cereal produced in Prussia is rye, which is consumed for bread and other food by the people in general in preference to wheat. About 75 per cent of the entire rye crop of Germany is raised in Prussia; 72 per cent of the potatoes, the crop next in importance; much of the latter is used in manufacturing alcohol; of the wheat Prussia yields 63 per cent, and of the oats 67 per cent. The vineyards of Prussia in 1913 aggregated 17,216 hectares and yielded 218,264 hectolitres of wine. The orchards and private gardens produced all the fruits of the temperate zone in abundance and excellent quality, notably cherries, plums, pears, apples, quinces, apricots and berries. In the whole of Prussia in 1913 there was grown of rye, on 4,935,425 hectares, some 9,345,155 metric tons; of potatoes, on 2,329,404 hectares, some 39,215,298 metric tons; of wheat, on 1,166,054 hectares, some 2,942,647 metric tons; and of oats, on 2,943,255 hectares, some 6,559,911 metric tons. Prussia excels also in livestock. The breeding of strong and generally serviceable horses has been made a special feature by the Prussian government. A score of royal studs in Teakehnrn, East Prussia, and elsewhere endeavor to keep up the grade suitable for army use, agricultural and general purposes, and the export of horses has been a regular feature. In 1913 the number of horses in Prussia was 3,387,301; of cattle, 12,344,507; of swine, 16,574,202; of sheep, 4,081,724. The total area of Prussia under forest is 22.7 per cent, and of this the fiscus owns about one-half, coniferous trees being in a vast preponderance. The government derives some $22,000,000 of its revenues from the profits on the sale of wood, etc., of its Crown forests. As to viticulture, practically all the palatable and economically valuable wine grown in Prussia comes from the Rhine and its chief tributaries, the Moselle, Nahe, etc. A number of the vineyards are owned by the state. All the wine-growers have suffered great losses for the past 30 years from the ravages of the phylloxera, but have got the trouble now under control. The better vintages of both Rhine and Moselle wines fetch high prices and are esteemed for their rare flavor. While fishing, both on inland waters (carp, pike, pickerel, trout, salmon, etc.) and the sea, is likewise an important source of income for Prussia, the fisheries on the Baltic and its «haffs» (herrings, sardines, anchovies, a species of cod, etc.) being of special value in pisciculture and deep-sea fishing Prussia is undoubtedly still far behind when compared with a number of other countries.

Manufactures.— From an industrially insignificant country Prussia during the last 40 years, with the remainder of Germany, has become a manufacturing centre of great importance. Among the industries that have grown up with almost spasmodic swiftness in Prussia within that period are the beet-sugar manufacture, in which Germany is leading the world and which flourishes mainly in the central provinces of Prussia; cotton spinning and weaving, which are of great importance in the Rhine province; the linen manufacture of Westphalia and Silesia; the woolen industry of the district around Aachen, as well as the silk and velvet production of Krefeld, Elberfeld, etc. In money value, however, the making of machinery of every description overtops all; Berlin, Magdeburg, Buckau and several large towns in Westphalia and along the Rhine, leading. The iron and steel industry centres in the coal region of the Ruhr Basin and is carried on on a very large scale, as in Essen, Remscheid, Suhl, Solingen, Düsseldorf, Elberfeld, Dortmund, etc. The most considerable shipyards in Prussia are located in Kiel, Danzig, Emden, Stettin and Elbing. Cologne, Görlitz, Königsberg and Düsseldorf are also noted for the making of smaller machines and mechanical devices, such as sewing machines, cash registers, typewriters, telephones, etc. Glass, paper, porcelain and pottery are turned out in the provinces of Saxony, Silesia and the Rhine, while the chemical and dye industry is mainly carried on in Berlin and in a number of towns by the Main and Rhine, as Höchst, Elberfeld, etc. Of those engaged in manufacturing and industrial establishments in 1911, 6,906,526 were employed in Prussia.

Transportation.— Prussia is well provided with all means of communication and transportation. The first railroad was built in 1838 and since 1866, after Prussia's annexation of Hanover, Hesse-Nassau and Schleswig-Holstein, the railroad system was rapidly extended, until, with one or two exceptions, of the larger countries Prussia possesses the closest network of rails. The same is true of her canal sytem. The shape of Prussia being twice as long as broad, these two systems, too, had to be laid out accordingly. Communication between the eastern and western provinces of Prussia is even more rapid and cheap than between the southern and northern ones. Steel lighters of large tonnage and small draft are now doing on the canals and rivers the transportation of the larger part of the bulky goods, manufactured goods and foodstuffs, carrying the latter westward and the former eastward. An enormous and steadily rising tonnage of such vessels, peculiarly adapted to their task, is devoted to this traffic. It is to the excellence of her water routes and railroad lines that Prussia owes much of its rise to economic prosperity. Dating from the eighties the Prussian railroads were gradually purchased by the state, following out a plan of Bismarck's, and by special agreements (called "Konventionen") with neighboring smaller states, such as Hesse, Saxony, Bavaria, and by embodying the railroads of a number of other adjoining states of less size, the serviceableness and income of the government-owned roads were guaranteed. The proportion of railway mileage in Prussia has now caught up with that of Great Britain, though in point of volume of traffic it is considerably behind, owing to the canal competition and to the fact that military-strategic reasons, rather than purely economic ones, have been deciding factors in laying out the railroads of Prussia. Significantly the most important trunk line of Prussia is that which runs from the western frontier at Herbesthal through Cologne, Berlin, Königsberg in the direction of Paris-Petrograd. For 1912 the Prussian railroad systems comprised 37,698 kilometers in length, all but 2,559 of which is state-owned and all but 520 kilometers being broad-gauge. It is admitted that in Prussia government ownership of railroads has proved an unqualified success from the financial and commercial point. Before the outbreak of the war the Prussian government derived just about one-fourth of its entire revenues from the profits of operating its railroads, while by controlling freight schedules at all times it was also enabled to lend a helping hand to industry as a whole. As to its merchant marine, next to that of Hamburg and Bremen, it was the most important of the several German states. Though the ports of the Baltic freeze over in winter, the one of Stettin, being nearest Berlin and, therefore, of greatest moment, is kept free by ice-breakers. Emden, a Prussian port on the North Sea, already of economic importance, was intended to become the rival of the two Hansa ports near by. The figures as to the size of the Prussian merchant fleet will have to be modified after the war. In 1913 the number of vessels was 2,329 of 318,646 tons net.

Banking and Finance.— The banking system is the same in Prussia as in the remainder of Germany. The Reichsbank (Imperial Bank) is at the same time the fiscal agent of Prussia, and its resources, privileges and emoluments have been repeatedly widened and expanded since 1871. Prussia, of course, is financially in a dominating position for the whole of Germany, since Berlin has become by far the most important financial centre of Germany, having outstripped Frankfort long ago. In Berlin there are 11 great corporate banks (aside from some powerful private banks) and the volume of business transacted by them is nearly as large as that of the Reichsbank with its 325 branches. The Deutsche Bank is the largest institution, followed by the Dresdner Bank, the Diskonto-Gesellschaft, etc. The Deutsche Bank has done enormous service in the spread of German commerce abroad, financing many transoceanic enterprises. Its capital and assets have increased 50-fold since 1871. Of vast importance, too, is the Preussische Seehandlung (Prussian Marine Association), which was founded by Frederick the Great and which was the main financial support of the government for over a century. The Preussische Seehandlung was the forerunner of the crédit mobiliers in France and other countries. While its capital stock is less than $10,000,000, its assets amounted, when the World War broke out, to $130,000,000. The Prussian (and German) banking system possesses great elasticity, a fact which is largely responsible for the avoidance of recurring great financial panics, at least since the one of 1873. As to finance, it has expanded and contracted by leaps and bounds similarly to that of other countries. In a general way it may be said that since 1891 Prussian finance has made enormous strides. As in all other civilized countries, however, the state itself has veered a good deal in its finances, depending largely in this on the diminishing or increasing revenues or the expenditures and vast economic state enterprises that have been undertaken from time to time, such as the purchase of the Prussian railroads, for instance. A certain degree of stability, though, is a consequence of the fact that a large section of the regular resources are coming in steadily and in predetermined bulk, such as the profits of the various state properties (railroads, fiscal lands, mines, forests, etc.). Taxation is, on the whole, on a satisfactory basis, a progressive income tax and other imposts being quite fairly apportioned. It must be kept in mind that Prussian finances are quite separate from those of the empire. From 1901 the Prussian budget has shown a rapidly rising scale. In that year it was (in marks) 2,885,017,665, for revenues, and 2,688,595,268 for expenses, while in 1915 it had risen to 4,848,881,000, for revenues, and the same (estimated) for expenses. The public debt of Prussia has likewise bounded upward for many years; in 1914 it amounted to 10,355,537,145 marks. By far the larger part of its load of debt has been incurred, up to the war, for productive enterprises, such as the acquisition of the railroads, domains, mines, etc.

Government.— In a certain limited sense Prussia was a country constitutionally governed. Its Constitution, the outcome of the short Revolution of 1848, dates from 1850 and was promulgated by the then king, Frederick William IV, but was in some (not vital) respects since amended or modified with royal sanction. The Constitution is a written instrument and could only be changed by concurrent resolutions, twice passed by the Prussian Parliament, the Diet, on these alterations being approved by the monarch himself. Executive power was vested in the king alone, the latter attaining his majority at 18. The Crown was hereditary and descended to the first-born male heirs in a straight line of succession through all the branches of the Hohenzollern dynasty. The king himself was irresponsible and exercised his powers through a cabinet, the members of which were not responsible for their actions to the Parliament, but to the king alone; he, too, both appointed and dismissed the ministers of the Crown. Members of the Cabinet had a seat in the Diet and participated in the debates. None of the ministers exercises more power than his colleagues, although the one directing the foreign policy was styed «Minister-President,» and presides at their meetings. The power of legislation and of raising taxes and disbursing public moneys is vested in the Diet. This parliamentary body (Landtag or Diet) is composed of two houses, the Abgeordnetenhaus (Chambers of Deputies) and the Herrenhaus (House of Peers). The electoral system, however, on which the membership of this Prussian Parliament was based was unfair, illiberal, antiquated and was stigmatized by Bismarck himself at a public session as «the worst in the world.» Despite repeated promises held out by the ex-Kaiser, as king of Prussia, to bring this election system more in accord with those in use in more enlightened countries, up to the end of the war no change had been made, due chiefly to the power of the «Junker» class of Prussia, who feared with reason to be deprived of their traditional predominant influence within the state if representative government were adopted in earnest. As it still stands at this writing the lower, i.e., the popular, more active and powerful, house is made up of 443 members, elected for a term of five years by indirect vote. For that purpose the country is divided into electoral districts, very uneven both as to size and population, in each of which usually one member is chosen by the three-class system. Under this plan the voters (all male Prussians of 25 and over who are not otherwise disqualified by reason of crime, extreme poverty, etc.) are cut up into three classes according to the amount of taxes paid by each. The moneyed class has so much the advantage under this preposterous system that generally one vote by a person of great wealth balances that of hundreds, even thousands, of humbler subjects. Together the three classes choose by open ballot an even number of electors, and these in turn make the final choice of a candidate, likewise by open ballot. Each chamber of the Diet again is the arbiter as to whether the choice was made properly, and may reject the candidate on evidence. Budgets and revenue bills must be passed by this lower house and cannot be amended by the higher. The Herrenhaus (House of Peers) again is made up of princes of the blood royal, of members of the higher nobility, of special titled members chosen by the estate-holders of Prussia, of representatives of universities and certain cities, and, lastly, of an indeterminate number of persons appointed by the king at pleasure. In 1915 the number of members of the Herrenhaus was 307, and about two-thirds of these represented, directly or indirectly, landholding (Junker) interests. While the general judicial system is the same throughout Germany, the judges themselves are appointed for life by the monarch; their position, although inferior in emoluments and standing to that in more Western countries, is on the whole fairly independent of outside influences. Judges must all have gone through a prescribed course of study and training to be fitted for office, and the standard is rigid and rather exacting. There are administrative courts («Verwaltungsgerichte») of various grades, special courts, jury courts («Schwurgerichte»), petty courts («Schöffengerichte»), etc. The highest courts are the 15 «Oberlandesgerichte»; next in grade the «Landesgerichte,» and «Schöffengerichte» being lowest. It is the «Reichsgericht» in Leipzig which decides, on appeal, cases handed up from the state courts, as an Imperial Supreme Court. As for local government in Prussia it is to-day largely the creation of Professor Gneist, the so-called «Kreisordnung» («Kreis,» provincial district), which dates from 1872. It gives decidedly a larger measure of local autonomy and has worked out on the whole very satisfactorily. For the purpose of administration Prussia is divided into 12 provinces, and these again into subdivisions, or «Regierungsbezirke» (government districts), 35 in all. Below these are the smallest units, the «Gemeinde» (community) and «Amtsbezirk» (administrative district). The administrative officers at the head of these various units are all appointees of the Crown and supposed to work in its interest and to preserve public loyalty toward the rulers and institutions of the country.

The Racial Population.— The table on following page shows the area and population of Prussia in each of its provinces from 1871 to 1910.

Increase in population has, as seen from the table, been very rapid since 1871, but at a steadily diminishing rate. This growth has been most rapid in Berlin, Westphalia, Rhineland, Brandenburg and Saxony, and least so in

PROVINCE	Square miles	Population, 1871	Population, 1900	Population, 1910
Brandenburg.	15,383.1	2.036,888	3,108,554	4,092,616
East Prussia.	14,286.5	1,822,934	1,996,626	2,064,175
Hanover.....	14,868.5	1,961,437	2,590,939	2,942,436
Hesse-Nassau	6,062.5	1,400,370	1,897,981	2,221,021
Hohenzollern.	441.0	65,558	66,780	71,011
Pomerania...	11,633.7	1,431,633	1,634,832	1,716,921
Posen.......	11,193.6	1,583,843	1,887,275	2,099,831
Rhineland...	10,424.8	3,579,347	5,759,798	7,121,140
Saxony......	9,755.7	2,103,174	2,832,616	3,089,275
Schleswig-Holstein...	7,343.2	1,045,419	1,387,968	1,621,004
Silesia.......	15,573.4	3,707,167	4,668,857	5,225,962
Westphalia...	7,806.8	1,775,175	3,187,777	4,125,096
West Prussia.	9,866.7	1,314,611	1,563,658	1,703,474
Berlin (city)..	24.5	826,341	1,888,848	2,071,257
	134,663.9	24,689,252	34,472,509	40,165,219

the rural districts; in fact, in many purely agricultural regions there has been a positive deline in population. During the Great War there has been an abnormal growth of population in a number of industrial and mining towns along the western border, a growth which, in the case of a few cities such as Essen, Düsseldorf, Dortmund, etc., has amounted to 200, even 300 and 400 per cent, owing to new enormous munition plants and other ephemeral economic causes. The annual rate of suicide in Prussia is exceptionally high.

Ethnologically considered, Prussia is by no means a country inhabited by a homogeneous population. Historically the core of Prussia, that is, the province of Brandenburg, is largely Slavic in origin, the Teutonic settlers and conquerors over the Slavic tribes (Wends, Sorbs) mingling with the latter; the eastern and northern provinces of Prussia are also, in varying degree, a mixture of Slav and Teuton. The very name of Prussia (Preussen) is derived from a small pagan nationality in the northern regions of the present kingdom, the Preussen or Borussi, who became (with also their language) entirely extinct. This large admixture of Slavic blood in the original provinces of what is to-day Prussia, viz., in the so-called Transelbia, the provinces of Brandenburg (Slavic: Brennabor), Pomerania, Posen, East and West Prussia and Silesia, has, of course, considerably altered the resultant population, both physically and in point of character, when comparing it with the more purely Teutonic stock in the west and south of Germany. So far as the latest official census figures of Prussia are concerned, those of 1910, they claim some 33,500,000 of the roundly 40,000,000 as Germans (the criterion being the language spoken at home); 3,500,000 as Poles, (in Posen, Silesia, East and West Prussia), 115,000 Lithuanians (in East Prussia), 142,000 Danes (in Schleswig), 75,000 Wends (in Brandenburg, Silesia), 30,000 Czechs (in Silesia) and 78,000 Walloons (near the Belgian border). In the rural districts of Posen and in portions of eastern Silesia and West Prussia the Poles form the vast majority of inhabitants. The above figures are merely approximative and do not include such fragments of foreign (Slav) race as the Kassubians of Pomerania and West Prussia, for instance, nor the 400,000 Jews or the foreign-born residents in Prussia, some 350,000 strong.

History.— The history of Prussia properly ought to begin, of course, with the assumption of the title of royal ruler over Prussia. The latter was a duchy (it is identical with the present province of East Prussia) to the far northeast of Brandenburg and had been wrested from its aboriginal owners, the heathen Borussi or Preussen, by the conquering and missionary zeal of the Teutonic Knights, a militant order of semi-monkish warriors, who, after their labors in Palestine were no longer needed, were entrusted by the Church of Rome with the task of christianizing that northern land. The Borussi appear to have been near relations of the Lithuanians, of whom a remnant have survived in the province. The Elector of Brandenburg, Frederick the III, having become heir to the lands of the defunct order of the Teutonic Knights, on the strength of an understanding with the then emperor of Germany, on 18 Jan. 1701, with elaborate ceremonies crowned himself in Königsberg, capital of the territory, «King in Prussia.» The emperor after much urging, acquiesced in this, but the proceeding created a peculiar status for the new king, who henceforth spoke of himself as Frederick I, as the «King in Prussia,» but remained nevertheless also Elector of Brandenburg and as such the subject lige of the emperor in Vienna. However, the whole method pursued by Frederick I was symbolical of what was to come. Frederick I was a Hohenzollern, descendant of that Frederick, an insignificant burgrave of Nuremberg, who, in 1411, by the grace of the Emperor Sigismond was called to wasted and utterly desolate Brandenburg as its margrave. From the accession of this energetic ruler in small Brandenburg dates, with several severe setbacks, the gradual rise to power of what became subsequently known in an enlarged sense as Prussia. The father of the first «King in Prussia,» the wise and pushing «Great Elector,» Frederick William (1640–88), laid the foundation to the greatness of his house by fortunate wars with Sweden and Poland, and his acquisitions of new territory in western Germany, as also by lucky treaties of hereditary accession. He defeated the Swedes at the pitched battle of Fehrbellin, helped the emperor with his troops in the War of the Spanish Succession, and left his somewhat scattered domains fairly prosperous and in good order. During the whole of the preceding century his predecessors had not played an important part, either in the Reformation era or in the Thirty Years' War, although they had seized the Church property within their lands and become adherents of the new religion themselves and had fallen heir to the dukes of Pomerania and thus prospectively enlarged their patrimony.

Frederick I, although a vain man and one who lived in a style of sumptuous luxury far beyond the scant resources of his state, nevertheless knew how to play his cards well as the leading Protestant prince in Germany, his particular rival, Augustus the Strong of Saxony, having been shortsighted enough to forego that rôle by forswearing his Lutheran faith in order to win the elective royal crown of Poland, a barren and costly honor. Nor was that all.

Frederick I purchased or otherwise acquired from spendthrift Augustus some important Saxon territory; he gained from William III of Orange the territories of Lingen, Mörs and Neufchâtel; he founded the University of Halle (1694) and at Berlin an Academy of Sciences and an Academy of Arts. Thus he left his states, overburdened by taxation and in an exhausted condition, though somewhat larger in size (1713). Fortunately for little Prussia his son, Frederick William I, was a man of quite a different calibre, a penurious, clear-headed, thoroughly practical man, with "no nonsense about him." And while the new king's education had been sorely neglected, so that he scorned all mere learning and ridiculed the very institutions his father had created, he had an innate genius for administration and for obtaining tangible power. His savings filled the empty treasury of Prussia; his army was not large, but well-drilled and equipped; by his wise economic policy he made Prussia the model of Europe in this respect; after lengthy bargaining with the Emperor Charles VI he was allowed the succession to the western duchies of Jülich (Juliers) and Berg, close to the Belgian and Dutch borders. As for his share in the tremendous wars during his reign in the North — Poland, Russia, Sweden under Charles XIV and Denmark being engaged — and in the West, they proved in a measure advantageous to him, as he secured the larger part of Swedish Pomerania. Much of the king's time was taken up with the negotiations carried on with the emperor relative to the Pragmatic Sanction and the succession of that monarch's daughter, Maria Theresa, to the throne. On both sides there was much duplicity, and finally Frederick William turned to the hereditary foe of the Hapsburgs, France, and that was the state of affairs when he died from an attack of the gout consequent on imprudent diet, on 31 May 1740, and a man of a very different fibre, his son Frederick II, subsequently surnamed the Great, stepped into his shoes. This son had been grossly maltreated by his ignorant father (whom he hated), so that at one time the young man had planned flight to his uncle, the king of England, and had been sentenced to death by his autocratic father for this piece of youthful folly. The old despot even forced his son to witness the execution of his friend and fellow-plotter, a young army officer named von Katt, but finally forgave him and restored him to favor. Young Frederick had passed the years immediately preceding his accession far away from his father's boorish and niggard court, on a small estate of his own, Rheinsberg, among some choice spirits, both French and German, and had there cherished ambitious dreams and polished his mind in all the refinements of art and learning of the period. Now, with 28, a good-looking, slender, blue-eyed young man, he mounted the throne, his head and heart full of things he meant to do to render his name famous. When Frederick II began his reign, Prussia had but 48,000 square miles and was thinly peopled. His father had left him the best disciplined army in Europe, numbering 80,000, and 9,000,000 thalers in the treasury, a sum equivalent to five times the amount to-day. Now Frederick could realize those day-dreams of his. At once he began a war of conquest against Austria for the possession of Silesia. After the first and second Silesian War had brought him this province, Frederick II, after a peace, began to consolidate and fructify his gains by wise economic measures. But in 1756 the so-called Seven Years' War broke out, Maria Theresa not having been able to reconcile herself to her loss. This tremendous and desperate struggle was waged with varying fortunes, until at last, by the Peace of Hubertusburg, Prussia was left in possession of Silesia. During the Seven Years' War, Frederick II had at times made headway against the combined power of France, Austria and Russia, and England, too, taking part, for or against Prussia. It was only by his undaunted energy and superior generalship that Frederick II was able to defend himself against these powerful coalitions. But when peace came, in 1763, Prussia was in a pitiful condition. In 1772 took place the first partition of Poland, in which Frederick II joined and by which Prussia profited. When at last, in 1786, Frederick died, he left his nephew and heir, Frederick William II (1786–97) a territory of 77,000 square miles with 6,000,000 subjects and an army of 200,000. During the 11 years' reign of Frederick William II the chief event was Prussia's alliance with Austria in order to put down the French revolution, a purpose in which they signally failed, and next to that the further acquisition of 40,000 square miles by the second and third partitions of Poland. Frederick William III (1797–1840) succeeded, by his weak and vacillating policy, in isolating Prussia and arousing the wrath of Napoleon. In 1806 Prussia was completely defeated at Jena, and her domain was reduced to less than half its former area. In 1813, however, Prussia acting in concert with Austria and Russia, Napoleon was at last overcome by sheer force of numbers and definitely disposed of. At the Congress of Vienna the former possessions of Prussia were restored and new ones added, especially the larger half of Saxony and the remaining portions of Pomerania, as well as valuable territories in the Rhine district. The promise of a liberal constitution given to the Prussian people was not kept. The only statesmanlike act of Frederick William III was the establishment of the *Zollverein* (or free-trade zone) which knitted northern Germany closer together. Frederick William IV (1840–61), a well-meaning monarch of great natural gifts, but of shifting character and erratic mind, went far toward destroying Prussia's prestige and military power, submitting abjectly to the political yoke of Austria. The part played by him during the revolution of 1848–49 was not free from duplicity. However, under pressure he granted a sort of constitution to his people. The last four years of his life he was insane, and on his death was succeeded by William I (1861–88). It was in his reign, in 1866, that the latent jealousy between Prussia and Austria finally burst into flame in one of the shortest and yet most decisive wars, a war lasting but six weeks. At Sadowa the ancient power and glory of Austria were overthrown and the path for aggrandizement thus made clear for Prussia. Most of the German states, outside of Prussia, had sided against her in 1866, and of these she annexed several at the Peace of Prague, including Hanover, Hesse-Cassel, Nassau and Schleswig-Holstein, thus raising Prussia to absolutely the dominant state within Germany and leaving her one of the leading military powers of the world. The Norddeutsche Bund (North German Confederation) was formed by Prussia, under the successful statesmanship of Bismarck, and the latter's farsightedness envisaged even then the war with France. This came about in July 1870 under circumstances which are not quite clear even to-day. Certain it is that Bismarck and the gifted Prussian chief of staff, von Moltke, together precipitated it by some clever juggling with a despatch from their king referring to the French Ambassador, Benedetti, and King William rousing the French emperor, Napoleon III and the French parliament to outbursts of fury and wounded pride and bringing on a declaration of war from France. The War of 1870–71, in which unexpectedly to the duped Napoleon III, by special previous agreements with Prussia, not only the states belonging to the North German Confederation, but also the Southern ones — Bavaria, Baden and Württemberg — joined, was disastrous for France from start to finish, and at the Peace of Frankfort, humbled France was forced to yield up Alsace and a portion of Lorraine, and an extortionate war indemnity of five billions of francs. While, however, the war still lasted, on 18 Jan. 1871, in the historical Salle de Glace at Versailles, the German princes offered the formal primacy of Germany and the imperial crown to King William of Prussia, who accepted and thus became the first German emperor. On 21 March 1871, the new Reischstag (or Imperial Parliament) met for its initial session at Berlin. From then on, therefore, the history of Prussia is properly but a part of that of the Empire as a whole.

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PRUSSIA, East, or **OSTPREUSSEN,** ōst-prois'sĕn, the northeasternmost province of Prussia, Germany. It is bounded in the south, east and north by Russia, and in the west by the Baltic Sea and West-Prussia. Area 14,320 square miles; pop. (1910) 2,064,175. Capital, Königsberg. See PRUSSIA.

PRUSSIA, West, or **WESTPREUSSEN,** vĕst-prois'sĕn, a northeastern province of Prussia, Germany. It is bounded in the south by Russian Poland and the Prussian province of Posen, in the east by East-Prussia, in the north by the Baltic Sea, and in the west by Pomerania. Area, 9,859 square miles; pop. 1,703,474. Capital, Danzig. See Prussia.

PRUSSIAN BLUE. See DYES.

PRUSSIAN BROWN, a color obtained by adding a solution of the yellow prussiate of potash to a solution of sulphate of copper, which throws down a precipitate of deep brown. This, when washed and dried, is equal to madder, and possesses greater permanency.

PRUSSIC ACID. See HYDROCYANIC ACID.

PRUTENIC, obsolete word meaning Prussian in astronomy, a term applied to certain planetary tables published by Erasmus Reinhold in 1551 founded on the principles of Copernicus. They were dedicated to a Prussian duke of that time and thus acquired their name.

PRUTH, prooth (Ger. proot), a river of Europe, which rises on the eastern side of the Carpathian Mountains, in the southeast of Galicia near the Hungarian frontier; flows circuitously east, then south-southeast, forming the boundary between Rumania and Bessarabia, and after a course of more than 500 miles enters the Danube on the left, about 12 miles below Galatz. For about 200 miles, from Jassy downward, it is navigable. On the bank of Pruth, near Husi, in 1711, the army of Peter the Great was surrounded by the Turks, and the Czar was not allowed his freedom until he ceded Azov to Turkey.

PRUTZ, proots, **Hans Georg,** German historian: b. Jena, Germany, 20 May 1843. He is the son of Robert Edward Prutz (q.v.), was educated in Jena and in Berlin and became privat-docent at the latter place in 1873. He was engaged in a government expedition into Syria in 1874, and in 1877 accepted the chair of history at the University of Königsberg, from which he resigned in 1902 and has since them resided in Munich. He has published ‹Heinrich der Löwe› (Leipzig 1865); ‹Kaiser Friedrich I› (3 vols., Danzig 1871–74); ‹Geschichte des Kreises Neustadt in Westpreussen› (Danzig 1872); ‹Radewins Fortsetzung der Gesta Friderici Imperator's des Otto von Freising, etc.› (Danzig 1873); ‹Aus Phönicien› (Leipzig 1876); ‹Quellenbeiträge zur Geschichte der

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PRUTZ, Robert Eduard, German poet and historian: b. Stettin, Prussia, 30 May 1816; d. there, 21 June 1872. He was educated at Berlin, Breslau and Halle, and edited, with Arnold Ruge, a radical periodical *Hallesche Jahrbücher* designed to promote more liberal views in science, politics and religion. His liberal views made him unpopular with the authorities who refused him permission to teach. However, in 1849 he became professor of literature at the university at Halle, but in 1859 resigned to devote himself exclusively to science and literature. His poetry is of the patriotic order, as are also his dramas; his novels display keen powers of satire, and his researches as a historian gave him high rank in that field of literature. As a public speaker, too, he ranked very high and during the latter part of his life, in spite of poor health, he was in great demand as a public lecturer. He was one of the founders and editor in 1851–66 of the *Deutsches Museum.* He also edited ‘Literarhistorisches Taschenbuch’ (6 vols., Leipzig 1843–44 and Hanover 1845–48); ‘Deutsche Dichter der Gegenwart’ (Prague 1859); ‘Holbergs Ausgewählte Komödien’ (translated from the Danish, 4 vols., Hildburghausen 1868). Amongst his plays, none of which are of great importance should be mentioned ‘Moritz von Sachsen’; ‘Erich, der Bauern König’; ‘Die Politische Wochenstube.’ They have been collected as ‘Dramatische werke’ (4 vols., Leipzig 1847–49). His novels, too, are of secondary importance, the best known, perhaps, being ‘Das Engelchen’ (3 vols., Leipzig 1851). As a poet he ranks much higher, especially in some of his lyrical poems. They include ‘Der Rhein’ (Leipzig 1840); ‘Gedichte’ (Leipzig 1841); ‘Ein Märchen’ (Leipzig 1841); ‘Gedichte Neue Sammlung’ (Zurich 1842); ‘Aus der Hesmat’ (Leipzig 1858); ‘Aus Goldenen Fagen’ (Prague 1861); ‘Herbstrosen’ (Munich 1864); ‘Mai 1866’ and ‘Juli 1866’ (Leipzig 1866); ‘Buch der Liebe’ (Leipzig 1869). The most important of his writings, however, consist of his historical and critical works ‘Der Göttingen Dichterbund’ (Leipzig 1841); ‘Geschichte des Deutschen Journalismus’ (unfinished, Hanover 1845); ‘Dramaturgische Blätter’ (Hamburg 1846); ‘Kleine Schroften zur Politik und Litteratur’ (2 vols., Merseburg 1847); ‘Vorlesungen über die Geschichte des Deutschen Theatres’ (Berlin 1847); ‘Vorlesungen über die Deutsche Litteratur der Gegenwart’ (Leipzig 1847); ‘Zehn Jahre 1840–1850 Geschichte der Neuesten Zeit’ (unfinished, 2 vols., Leipzig 1850–57); ‘Neue Schriften, etc.’ (2 vols., Halle 1854); ‘Goethe’ (in ‘Unterhaltende Belehrung,’ Vol. XXVII, Leipzig 1856); ‘Ludwig Holberg Sein Leben und Seine Schriften’ (Stuttgart 1857); ‘Deutsche Litteratur der Gegenwart’ (2 vols., Leipzig 1859); ‘Menschen und Bücher’ (Leipzig 1862). Consult Anon., ‘R. E. Prutz’ (in ‘Moderne Klassiker,’ Vol. XLIV, Cassel 1852); Buettner, G., ‘Robert Prutz’ (in *Teutonia Arbeiten zur Germanischen Philologie*, part 25, Leipzig 1913); Gottschall, R. von, ‘Robert Prutz’ (in *Unsere Zeit*, Leipzig 1872); Mähly, J., ‘R. E. Prutz’ (in ‘Allgemeine Deutsche Biographie,’ Vol. XXVI, Leipzig 1888).

PRYCE, Richard, English novelist and playwright: b. Boulogne, France, 14 May 1864. Among his fictions, many of which have been reissued in this country, are ‘An Evil Spirit’ (1887); ‘The Ugly Story of Miss Wetherby’ (1889); ‘A Just Impediment’ (1890); ‘The Quiet Mrs. Fleming’ (1890); ‘Deck-Chair Stories’ (1891); ‘Miss Maxwell's Affections’ (1891); ‘Time and the Woman’ (1892); ‘Winifred Mount’ (1894); ‘The Burden of a Woman’ (1895); ‘Elementary Jane’ (1897); ‘Jezehel’ (1900); ‘The Successor’ (1904); ‘Towing-Path Bess’ (1907); ‘Christopher’ (1911); ‘David Penstephen’ (1915); ‘Statue in the Wood’ (1918). He has also written the following plays: ‘Little Mrs. Cummin’ (1909); ‘The Visit’ (from stories by M. E. Mann, 1909); ‘Helen with the High Hand’ (from the novel by Arnold Bennett, 1914); together with F. Fenn, ‘Op-o’-me Thumb’ (1904); ‘The love Child’ (1910); together with W. P. Drury, ‘A Privy Council’ (1906), and together with A. Morrison, ‘The Dumb-Cake’ (1907). Consult Carney, F. T., ‘Richard Pryce. An Appreciation’ (in *Bookman,* Vol. XXXVII, p. 520, New York 1913).

PRYNNE, prin, **Hester,** the principal character in Nathaniel Hawthorne's romance, ‘The Scarlet Letter’ (q.v.), published in 1850. For her sin with the young minister, Arthur Dimmesdale, she was condemned to stand holding her child upon the platform of the pillory in the sight of the populace and wear a scarlet letter A embroidered upon her bodice. This badge of her shame was worn thereafter, while she did expiation by deeds of mercy among her townspeople. Consult Howells, W. D., ‹Heroines of Fiction› (Vol. I, p. 161, New York 1901).

PRYNNE, William, English author and politician: b. Swainswick, near Bath, Somerset, 1600; d. London, 24 Oct. 1669. He was graduated at Oriel College, Oxford, in 1621 and admitted to the bar in 1628. He early became a militant Puritan, wrote pamphlets against Arminianism and the frivolities of the age and in 1633 published a huge volume, entitled ‹Histrio-Mastix, the Players' Scourge,› further devoted to assaults on theatres, court masques, cards and music. Passages alleged to reflect on the king and queen brought down on him savage punishment. He was prosecuted by the Star Chamber and underwent sentence which included the payment of a £5,000 fine, expulsion from Lincoln's Inn and loss of his degree, having his work burned by the hangman, the loss of his ears, exposure in the pillory and imprisonment in the Tower. Unbroken in spirit he issued tracts from prison, one of which he facetiously entitled ‹News from Ipswich,› against Archbishop Laud and other prelates, calling them, among other names, «Luciferian lord bishops, execrable traitors, devouring wolves.» The Star Chamber, in consequence, ordered what remained of his ears again cut off, fined him another £5,000 and had the letters S. L. (seditious libeler) branded on both his cheeks. He remained in prison — still vigorously writing, though, because of a stricter guard, not for the public — till 1640. He was then released by the House of Commons, was awarded damages and made a triumphal entry into London. Later he was member of Parliament for Newport in Cornwall and took part in the prosecution of Laud, but was expelled by Cromwell in 1648 for opposition to the extreme measures leading to the execution of the king. He now published such virulent articles against Cromwell that he was twice imprisoned. In 1660, after Cromwell's death, he again sat in Parliament and upon the Restoration was made keeper of the records in the Tower. Pamphleteering again brought him into trouble with the House of Commons, but he recanted, and busied himself with the collection of Parliamentary records. He produced more than 200 volumes, of which the most valuable are ‹Collection of Records› and ‹A Brief Register, Kalendar and Survey of Parliamentary Writs› (4 parts, London 1659–64). A fairly exhaustive list of his writings and their many editions will be found in ‹British Museum Catalogue of Printed Books› (p. 159–183, London 1895). The most authoritative list of them is attached to S. R. Gardiner's work published by the Camden Society and mentioned below. Consult Bliss, P., ed., ‹A à Wood's «Athenæ Oxoniensis»› (new ed., Vol. III, p. 844, London 1817); Firth, C. H., ‹William Prynne› (in ‹Dictionary of National Biography,› Vol. XLVI, London 1896); Gardiner, S. R., ed., ‹Documents Relating to Proceedings against William Prynne› (in *Camden Society Publications,* n. s. Vol. XVIII, Westminster 1877); id., ‹History of England 1603–42› (Vols. VII–IX, London 1884); id., ‹History of the Great Civil War› (3 vols., London 1888–91); Peach, R. E. M., ‹The Annals of the Parish of Swainswick› (London 1890).

PRYOR, Nathaniel, American soldier, trader and explorer: b. (probably) Amherst County, Va., about 1785; d. Los Angeles, Cal., 1850. He was a great grandson of Nicketti, daughter of Powhatan and sister of Pocahontas. Left an orphan in infancy, he was taken to Kentucky by the family of his maternal uncle, Charles Floyd. In 1803, he enlisted as a private soldier in the army for the purpose of accompanying Lewis and Clark on the expedition across the continent to the mouth of the Columbia. Returning in 1806 with the rank of a sergeant, he was commissioned an ensign and assigned to the command of the detachment sent to escort Shahaka, the Mandan chief to his home on the Upper Missouri in 1807, but failed because of the hostility of the Arikara Indians. He was promoted to a lieutenancy in 1808 and resigned from the service in 1810, engaging in trading and lead mining. During the War of 1812, he re-entered the military service and was discharged at its conclusion with the rank of captain. He then became a trader among the Osage Indians, in Oklahoma, operating a trading post near the mouth of the Verdigris River part of the time. In 1821 he joined Fowler and Glenn on their trading expedition to the Rocky Mountains. In 1824 he joined the Pattie's on their trading expedition to the Rocky Mountains and followed all of their wanderings until they arrived in southern California, where the entire party was imprisoned. After his liberation he settled at Los Angeles where he remained until his death. Pryor Creek and the town of Pryor, county-seat of Mayes County, Okla., were named for him. Consult Nuttall's *Journal*; Long, Stephen N., ‹An Expedition from Pittsburgh to the Rocky Mountains, Performed in the Years 1819 and 1820›; Coues, Elliott, ‹The Journal of Jacob Fowler›; Flint, Timothy, ‹Pattie's Narrative,› and James, Thomas, ‹Three Years among the Indians and Mexicans.›

PRYOR, prī'ôr, **Roger Atkinson,** American lawyer: b. Dinwiddie County, Va., 19 July 1828; d. 1919. He was graduated at Hampden-Sidney College in 1845 and at the University of Virginia in 1848 and was admitted to the bar in 1849. For a number of years he was editor of newspapers in Petersburg and Richmond, Va., and in 1855 was appointed special minister to Greece by President Pierce; sat in Congress 1859–61 and in the Confederate Congress in 1862. He entered the Confederate army with the rank of colonel in 1861; was brevetted brigadier-general in 1862, but resigned his commission and re-entered the army as a private. From 1864–65 he was a prisoner at Fort Lafayette, N. Y. After the war he settled in New York City where he was admitted to the bar in 1866. From 1890–94 he was a judge of the Court of Common Pleas and from 1894 to 1899 was justice of the State Supreme Court. He then resumed the practice of law. He published ‹Essays and Addresses› (New York 1912). Consult Hardy,

S. E. M., ‘Roger A. Pryor’ (in *Green Bag*, Vol. X, p. 161, Boston 1898).

PRYTANEUM, the building in the capital of a Greek state possessing similar features to the town-hall of modern communities, but having in addition a religious significance and devoted to purposes peculiar to the Greek state. It was dedicated to Vesta and contained the perpetual fire of the state hearth. At Athens (q.v.) the state here entertained as public guests its foreign ambassadors, its envoys returned from a public mission, its distinguished generals, victors in the Panhellenic games and citizens who had done important service to the state. In the latter case the privilege lasted for the life-time of the recipient. The exact location of the Athenian Prytaneum has never been determined. In the same manner each city and village had its prytaneum, forming the religious and political centre of the community. Consult Michel, C., ‘Prytaneum’ (in Saglio, E., and others, ed., ‘Dictionnaire des Antiquités Grecques et Romaines,’ Vol. IV, pt. 1, p. 742, Paris 1907); Poland, F., ‘Geschichte des Griechischen Vereihswesens’ (Leipzig 1909).

PRZEMYSL, pzhĕm'isl, Austria, one of the oldest towns in Galicia, on the river San, 51 miles west of Lemberg. It is strongly fortified, being a place of strategic importance. It has an active trade and thriving industries. Przemysl was founded in the 8th century by the Polish prince Przemyslaw, and called after his name. The ruins of the ancient residential castle are on a neighboring hill. During the European War Przemysl was invested by the Russians in September 1914. For about two weeks in October the investment was broken, and troops, arms and provisions were hurriedly transported to the fortress. By 12 Nov. 1914 the town was completely cut off again and besieged by General Selivanoff. On 22 March 1915 the town surrendered with nine generals, 2,500 officers and officials and 117,000 men. In the great Galician drive of von Makensen in the summer of 1915, when the Austro-German forces stood at the gates of Przemysl, the whole Russian garrison disappeared from the town during the night of 2–3 June 1915.

PSALMANAZAR, săl-mą-nă'zėr, **George** («The Formosan»), French literary imposter: b. probably in Languedoc, France, about 1679; d. London, England, 3 May 1763. He was educated by the Jesuits, led a vagrant life in Brabant, Flanders and Germany, posing as a Japanese convert. Later he enlisted in the Dutch service, and finally attracted the attention of Innes, chaplain of a Scottish regiment at Sluys, Holland, who apparently converted him to Protestantism and took him to England, where he was presented to Bishop Compton and others as a native of Formosa. Whether Innes was duped by Psalmanazar or was an accomplice is uncertain, but the supposed Formosan was treated with great honors, encouraged to write ‘An Historical and Geographical Description of Formosa’ (1704), translated parts of the English Catechism into the pretended Formosan language, and later was sent to Oxford. A few years later he published ‘A Dialogue between a Japanese and a Formosan’ (1707). He repented of his imposture, however, confessed his duplicity, and devoted himself to study. He became a fine Oriental scholar and led a much respected life in London. He wrote ‘Essays on Scriptural Subjects’ (1753); several volumes of the ‘Universal History’; and completed Palmer's ‘History of Printing’ (1732). Consult autobiographical ‘Memoirs of . . . commonly known by the name of George Psalmanazar’ (1764).

PSALMODY, săl'mō-dĭ or sä'mō-dĭ, a singing of the Psalms (q.v.) of Scripture in metrical versions to simple tunes. Psalms and hymns were sung in the religious assemblies of the early Christians; and the psalms of Scripture form the bulk of the daily religious service or «Divine office» of the Catholic Church, the custom having been borrowed from the synagogue and the temple of Jerusalem. After the Reformation in the 16th century psalmody was greatly encouraged in the Protestant churches of Germany, France and the Low Countries, and most of the psalm melodies now sung in churches were composed or adapted by German musicians of the 16th century. Metrical versions of the Psalms were made in German, French and English. The Scotch reformers paid great attention to psalmody: in John Knox's psalter the Sternhold and Hopkins metrical English version of the psalms was arranged with four-part harmony. The metrical version now used in Scotland is the one made by Francis Rous during the Commonwealth and approved by the General Assembly of the Scottish Church. Consult Armknecht, F., ‘Die Heilige Psalmodie’ (Göttingen 1855); Bonner, D. F., ‘The Psalmody Question’ (New York 1908); Cooper, J. S., ed., ‘True Psalmody’ (Philadelphia 1859); Kent, C. F., ed., ‘The Songs, Hymns and Prayers of the Old Testament’ (New York 1914); Parker, W. H., ‘The Psalmody of the Church, Its Authors, Singers and Uses’ (New York 1892); Soullier, E., ‘Les Origines de la Psalmodie’ (Paris 1901).

PSALMS, Book of. Title.— The Old Testament gives no title to the book as a whole. The ordinary Hebrew designation for the book is *Sepher Tehillim*, meaning *Book of Praises.* The common title in the Setptuagint is *Psalmoi, Psalms*, a designation taken from one of the minor collections of the book. This Septuagint title has been followed in most of the versions, including the English.

Authorship, Date and Compilation.— The titles of the individual psalms contain many statements which have usually been considered to be ascriptions of authorship to various persons. These statements consist of proper names preceded by the Hebrew preposition *le*, which may denote authorship, but may also mean *belonging to* in more general significations. Most prominent of these statements is the title in which the Hebrew preposition precedes the name *David*, the combination being usually rendered *of David.* This is found with 74 psalms, the actual authorship of David being impossible in a large majority of these, as shown by the circumstances, language and thought. If this title was intended to indicate authorship, therefore, it was in most cases erroneous. The 12 psalms with the title *of Asaph*, also, could not have been written by Asaph, who was a contemporary of David, the psalms being of much later origin. The title *of the sons of Korah*, in 11 psalms, can hardly have been intended to indicate authorship by a group. The sons of Korah, according to 2 Chron. xx, 19 and elsewhere, were a guild of temple singers after the exile. In the light of these facts it is now often and preferably held that these titles were not intended, in most cases, to indicate authorship, but to show that the individual psalm had belonged to a minor collection of psalms designated by the name in question, *sons of Korah* designating a collection used especially by the guild of the sons of Korah, and *Asaph* indicating a collection used by the Asaphite guild, which was also prominent after the exile. Several other minor collections are also indicated by the titles, the Hebrew names of these collections being Shir, Miktam, Maskil, etc. Most of the psalms were in more than one of these minor collections, some in one only, a few in none. The evidence indicates that when a compiler used a psalm from an earlier collection he put the name of the collection, or a term derived from the name, as a title at the head of the psalm; when used again a second title was added, etc. It is probable that at least 10 of these minor collections which preceded the present psalter can be traced, the earliest having been made soon after the exile, and the latest in the early Greek period or somewhat later. The Elohistic Psalter, one of these minor collections, needs special consideration for some of its peculiarities. This embraces Psalms xlii–lxxxiii, and is characterized by a great preponderance of the use of the divine name Elohim, in the present text not to the entire exclusion of the term Yahweh, but perhaps originally so. This was probably partly a matter of original composition, but was certainly in some measure due to editorial change. Such editorial change appears clearly from the fact that Psalm liii is an Elohistic recension of Psalm xiv, and Psalm lxx, of Psalm xl, 13–17, and also from a few other details. The reason for the use of the divine name Elohim, both originally and editorially, is very uncertain. It doubtless represents the usage of some circle or region. The documents of the Hexateuch, it is well known, present similar phenomena, but as those were written much earlier there may be no direct connection. It seems hardly probable that the usage is due to the superstitious avoidance of the divine name Yahweh, which was common later. Psalms cxx–cxxxiv constitute a collection usually called «Songs of Ascents,» and supposed to be pilgrim songs sung by those who were going up to the great feasts at Jerusalem. The title should probably be rendered «Exalted Songs,» describing the collection as distinguished by special elevation of thought and feeling, which is in harmony with their character. They have also unusual regularity of form. There are also indications of other small collections not as definitely marked as those which have been described. Thus Psalm cxxxv, 21 has the appearance of being a doxology originally closing a small collection. There are indications, also, that the closing doxology of book four was originally the doxology closing a small collection. Psalms xciii, xcv–c are marked by many similarities to one another, and probably formed originally a small theocratic collection. The complete Book of Psalms as it now exists, or practically so, was probably compiled about 200 B.C., allusions in the book of Ecclesiasticus, written about 180 B.C., making it probable that it was practically complete at that time. It is now generally held that only a small part of the psalms are of pre-exilic composition. The division into five books doubtless did not take place during the compilation, but later after the compilation was complete, following the analogy of the divisions of the law.

Other proper names appear in the titles of the psalms with the Hebrew preposition *le*. These are Solomon in 72 and 127; Moses, 90; Ethan, 89; and Heman, 88. It is probable that no one of these marks a collection, and hence that the titles were designed to indicate authorship. But none of them were written by the respective authors indicated. It is probable, therefore, that these psalms should be regarded as pseudonyms, later compositions considered to be in the spirit of these men.

Davidic Psalms.— The number of psalms to be ascribed to David is a much-disputed question. The opinion was held earlier that nearly all the psalms were written by David. It is still believed by some that as many as 40 psalms were written by him. On the other hand, his authorship of any psalms is often denied at the present time. The character of David and the general level of the thought of his time are not favorable to the opinion that he was the author of many psalms. Nevertheless, compositions similar to the psalms are earlier than David, and he is by tradition closely connected with the psalms, while his general musical ability is several times noted. The Davidic authorship seems probable for Psalms iii, vii, xiii, xviii and xxiv, 7–10. These are simple in thought and style and have a pronounced warlike element.

Thirteen psalms contain in their titles references to specific events in the life of David which are said to have called them forth. The notice might be correct in the case of Psalm 18, but in every other case the notice is definitely out of harmony with the contents of the psalm, 10 of the psalms being quite certainly not of Davidic authorship. These notices are probably later traditions of no historical value, or else illustrative additions made by a later compiler.

Maccabean Psalms.— Some have thought that many psalms were written during the Maccabean period beginning in 168 B.C. The religious devotion and patriotism of the early Maccabean period might naturally have prompted such expression, and some are in a measure appropriate to that time. In the Maccabean period, however, Hebrew, it seems evident, had been replaced as a spoken language by Aramaic (consult Buttenweiser, 'Are There any Maccabean Psalms,' *Journal of Biblical Literature*, XXXVI, 1917, pp. 225–248). Hence Hebrew, if used, would have been employed in an artificial and inexact manner such as does not appear in the psalms. The Maccabean origin of any psalms is therefore improbable.

Musical and Liturgical Titles.— Besides the elements in the titles already discussed, musical and liturgical instructions are also found. Examples of the liturgical statements are: «For the Sabbath day» in the title of Psalm xcii; «A song at the dedication of the house» in the title of Psalm xxx, etc. The liturgical titles are much later than the psalms themselves, and are added only in a few cases, in no systematic way; they evidently represent the usage of the Jews at the time of their addition. The Septuagint has several additional liturgical assignments.

Musical directions form part of the title in thirty psalms. It is probable that they were first added in the Elohistic Psalter, 20 of them being found there. These titles are of three kinds: references to musical instruments; references probably to voices although possibly to the effects of musical instruments; and references to the melodies in accordance with which the psalms are to be sung, a melody being usually designated by one or more of the opening words of a well-known song with which it is associated.

Community Psalms.— In Psalm cxxiv it is explicitly said that the speaker is Israel. In a considerable number of psalms which are expressed in the first person the obvious view is that the speaker is the community or the nation, or at any rate some considerable portion of the people. The question has been much discussed in recent years whether this is not the correct understanding of many or most of the psalms written in the first person singular, instead of the individual interpretation. The question is one to be settled in each case by the evidence at hand, with no definite presumption in favor of either view. The indications of an individual interpretation are strongly marked individual traits. The indications of a community interpretation are the absence of such strongly marked individual traits, and also the presence of elements of experience which are difficult to reconcile with an individual interpretation, or more strongly suggest some community experience. The result is that many of these psalms seem to be individual, and many to belong to the community. Doubtless in some cases an original individual psalm has been revised to make it more appropriate for community use, but this is a process difficult to trace.

The Poetical Character of the Psalms.— There is much difference of opinion concerning the essential nature of Hebrew rhythm. Many regard accent as its essential feature; but the better view seems to be that, in the very nature of the case, duration of time, rather than accent, is always the fundamental element in rhythm. The Hebrew foot, therefore, has the same essential nature as the classical foot, but is more elastic. The Hebrew foot may be defined as follows: A group of syllables, more or less in number, which, together with any silences that may be included, occupies in utterance a time relatively fixed, that is, the same as other feet in the same composition (consult Lanier, ‘The Science of English Verse,’ p. 40). The number of feet in a line in the Psalms varies from two to six, there being a measure of uniformity in an individual psalm. The normal stanza consists of two lines, being ordinarily a verse. A division into strophes, a regular combination of several stanzas, is found occasionally, but is no regular feature of Hebrew poetry, although many consider it to be such. This division into strophes, when found, is sometimes marked by a refrain. Parallelism of the lines of a stanza is frequent but not universal, parallelism being also found in Hebrew prose. Assonance, particularly the repetition of the same word in lines near together, especially in the two lines of a stanza, is frequent. Most of the Psalms are lyric, a few didactic while a few have a dramatic element. Psalms ix, x, xxv, xxxiv, xxxvii, cxi, cxii, cxix, cxlv have the alphabetic or acrostic structure, in which the separate lines, or stanzas (verses), or two successive stanzas, begin in Hebrew with the successive letters of the alphabet. Ps. cxix, however, is distinguished by being divided into sections of eight verses, each verse in a section beginning with the same letter.

The Thought of the Psalms.—As the psalms are for the most part lyric they are primarily an expression of feeling. Hence a presentation of thought would naturally be in a less connected form than in other parts of the Old Testament. Nevertheless, the book contains the principal phases of thought found elsewhere in the Old Testament. The imprecations found in abundance in several of the psalms constitute their principal defect to the thought of the present day. Yet that feature is easily intelligible when approached historically and constitutes no real difficulty when understood in relation to the time. Several of the psalms show an attitude that is favorable toward the ritual worship, yet with no presentation of its details. For the most part, however, the general attitude of the psalms is in accord with that of the prophets. The lyrical element in the psalms, their character as an expression of deep religious feeling, gives them an appeal to the feelings of men through the ages. While much is in form local and national, there is often an underlying universality of spirit which gives them permanent value as one of the supreme products of the thought and feeling of humanity in fellowship with God.

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PSALTER, sâl'tėr, the Book of Psalms (q.v.); also a book containing the Psalms separately printed; also specifically, the version of the Psalms in the English Book of Common Prayer. It is also the name of an ancient string instrument of music, the Hebrew *Kinnor*; called by the Germans Rotta (*Cĭthara Teutonica*). Sometimes the rosary of 150 beads used by some order of nuns is called the Psalter, as the Psalter contains 150 Psalms. Consult Bovet, F., ‘Histoire du Psautier des Eglises Reformies’ (Neuchâtel 1872); Jordan, W. G., ‘Religion in Song, or Studies in the Psalter’ (London

1915); Mackmeeken, J. W., 'History of the Scottish Metrical Psalters' (Glasgow 1872); Strauss, O., 'Der Psalter als Gesang — und Gebet-Buch' (Berlin 1859); Whitham, A. R., 'Christian Use of the Psalter' (London 1908).

PSAMMETICHUS, sạ-mĕt'ĭ-kŭs (Greek *ψαμμήτιχος*, Egypt Psammetk), the name of three rulers of the 26th dynasty. Psammetichus I, first monarch (664–610 B.C.) succeeded his father, Necho, who had been chief of 20 local princelings and vassal of Asurbanipal, King of Assyria. He is first heard of as feudal lord of Saïs, the chief centre of the western delta. He formed an alliance with Gyges, king of Lydia, against the suzerain power of Assyria; and by the aid of Carians and Ionian Greeks supplied by Gyges, defeated the Assyrian vassal-kings and was crowned «lord of the two Egypts.» Herodotus says he blockaded Azotus (Ashdod) for 20 years; and he may indeed frequently have besieged it. He made Phœnicia a vassal state, and devoted much attention to art and architecture. The demotic (or enchorial) writing which, because of greater facility, superseded the hieratic, was invented during his reign, though it cannot be ascribed to his initiative. Psammetichus II (594–589 B.C.), was grandson of the above. His reign is of note chiefly because of the inscriptions made at Abu Simbel (q.v.), by his Greek, Carian and Phœnician mercenaries. Psammetichus III (526–525 B.C.) was last king of the dynasty. His reign was brought to a close by the Persian conquest, and Egypt became a province of Persia.

PSARA, psä'rä, or **IPSARA** (Gr. *Psyra*), an island belonging to Greece, in the Ægean Sea, seven miles northwest of Khios; about five and a half miles in length, and as many in breadth. It consists almost entirely of rock, thinly covered with a vegetable mold. At one time it had considerable commerce, and a population of 30,000. However, in 1824 it was invaded by Turkey, and after having been devastated most of its inhabitants were killed. As a result of the Balkan Wars (q.v.) of 1912–13 and of the Treaty of London it was, in 1914, annexed, with the consent of the Great Powers, by Greece. Pop. about 4,500.

PSEUDEPIGRAPHA. See Apocalyptic Literature.

PSEUDO-ISIDORIAN DECRETALS. See Decretals.

PSEUDOLEUCÆMIA, sū"dō-lū-sē'mi-ạ, or **HODGKIN'S DISEASE**, a disorder of the lymphatic glands and sometimes an affection of the spleen, characterized by anæmia and progressive hyperplasia. It is also attended by secondary lymphatic growth variously distributed in the body. Leucocytosis — excess of white corpuscles in the blood — which accompanies many blood diseases, is not present in pseudoleucæmia. See Blood.

PSEUDOMORPH, the name applied to a mineral which has replaced another, or which appears in crystal forms which are foreign to its original formation. Massive varieties of minerals are more subject to such changes, but the action is frequently more difficult to trace. There are three kinds: Pseudomorphs, epimorphs, and paramorphs. See also Mineralogy.

PSEUDONYM (Fr. *pseudonyme*, from Gk. *pseudonymos*). A name adopted by an author who desires to remain unknown, or assumed for the purpose of attracting more attention at first than might follow from the use of the author's own name. (See Anonymous). Pseudonymous authorship raises certain legal points as to the rights of the author under the Copyright Law (q.v.). In the United States it has been held, though not always, that a copyright acquired under a pseudonym protects fully the actual author if he is the user of the pseudonym. In practically every civilized country there have been published a number of works listing and revealing the pseudonyms used by their respective authors. For pseudonyms used by the authors of France, Germany, Great Britain, the Middle Ages and the United States. Consult Barbier, A. A., 'Dictionnaire des Onorages Anonymes et Pseudonymes' (3d ed., 4 vols., Paris 1872–79; supplement, edited by P. G. Brunet, Paris 1889); Celani, H., 'Additions et Corrections au Dictionnaire des Anonymes de Barbier' (in *Revue des Bibliothèques*, Vol. XI, p. 333, Paris 1901); Courtney, W. P., 'The Secret of our National Literature' (London 1908); Cushing, W., 'Initials and Pseudonyms' (2 vols., New York 1885–88); Franklin, A. L. A., 'Dictionnaire des Noms, Surnoms, et Pseudonymes Latins de l'Histoire Litteraire du Moyen Age, 1100–1530' (Paris 1875); Halkett, S., and J. Laing, 'A Dictionary of the Anonymous and Pseudonymous Literature of Great Britain' (4 vols., Edinburgh 1882–88); Haynes, J. E., 'Pseudonyms of Authors' (New York 1882); Holzmann, M., and J. Bohatta, 'Deutsches Pseudonymen Lexikon' (Vienna 1906); La Fare, A., ed., 'Petit Dictionnaire des Pseudonymes' (in 'Tort-Paris,' p. 802, Paris 1918); Manes, A., 'Das Recht des Pseudonyms' (Göttingen 1899); Marchmont, F., 'A Concise Handbook of Literature Issued under Pseudonyms and Initials' (London 1896); Querard, J. M., ed., 'Les Supercheries Litteraires Devoilées' (3d ed., 3 vols., Paris 1869–70); Thomas, R., 'Handbook for Fictitious Names' (London 1868); Id., 'Aggravating Ladies: Being a List of Works Published under the Pseudonym of «A Lady»' (London 1880); Weller, E., 'Lexicon Pseudonymorum; Wörterbuch der Pseudonymen aller Zeiten und Völker' (Regensburg 1886).

PSEUDOSCOPE, *in optics*, an instrument, invented by Wheatstone, for producing an apparent reversion of the relief of an object to which it is directed, by the transposition of the distances of the points which compose it. A false impression is thus conveyed to the eye, a globe becoming apparently concave and a hollow body assuming a convex form. See Optics.

PSEUDOSUCHIA, an order of *Crocodilia*. See Herpetology.

PSILOMELANE, a hard, dull, black mineral, essentially a hydrous manganese manganate, but part of the manganese often replaced by barium or potassium. It occurs abundantly massive or in botryoidal and stalactitic forms in Germany, England, Arkansas and many other localities. It is one of the commonest ores of manganese.

PSITTACI, sĭt'ạ-sī, the parrot tribe, a family of scansorial birds, comprising over 300 species, of which the genus *Psittacus* is the type. See PARROT.

PSKOV, pskŏf, or **PLESKOV,** Russia, (1) town, capital of the government, on the right bank of the Velikaya, which here receives the Pleskova, 165 miles south-southwest of Petrograd, with which, as also with a number of other cities, it is connected by railroads. There is also a steamship line between Pskov and Dorpat. It is walled, flanked with towers, all in a very delapidated state, as are also many of the houses. It consists of the Kremlin, the Central city, the Great city and a considerable suburb. All the private houses and the far greater part of the public edifices are of wood. The finest buildings are in the Kremlin. The principal manufacture is Russian leather; and there is a considerable trade in hemp, flax, tallow, hides, etc. Pskov is the see of an archbishop and possesses a theological seminary, a well-managed hospital, an ancient cathedral and other old churches and monasteries, most of the latter being in ruins. It is said to have been the birthplace of the Princess Olga toward the end of the 10th century. During the Middle Ages it possessed great importance as a trading centre and for a long time maintained its freedom as a city republic, which it lost in 1509 when it came under the rule of Moscow. It went through a number of sieges and gradually deteriorated, though with the coming of railroads, it regained some of its former mercantile prosperity. Pop. 38,300.

(2) A government of Russia, bounded north by Petrograd, northeast by Novgorod, east by Tver, southeast by Smolensk, south by Vitebsk, west by Livonia; area, 16,678 square miles. The surface toward the southeast is traversed by the Valdaï Hills, but sinks gradually down near the centre, having only a gentle slope toward the north and west. The soil is throughout of poor quality and can only be made to yield tolerable crops by fertilization. Wheat is seldom grown, and the principal crops are flax, oats and barley, which are raised in considerable quantities, so as to leave a surplus for export. Forests are extensive; but the wood is not of the best quality. The only other manufacture of importance is leather. There are more than 800 lakes in the government, covering about 390 square miles. The largest of these is Lake Pskov (300 square miles). Over 1,200 square miles are covered by marshes. Pskov is divided into eight districts. The majority of its population are Great Russians. Pop. 1,447,000.

PSORIASIS, sō-rī'ạ-sis, chronic skin disease, allied to alphus and lepra, non-contagious but often hereditary. It is characterized by an inflammatory condition, with slightly elevated patches, dry and various in number, size and shape, to which grayish scales adhere. These exfoliate, to be repeatedly renewed. The extensor sides of the extremities, the elbows, knees, trunk and scalp, became first affected, and the flexor sides of the limbs are afterward attacked. Only the mucous membranes of the body are exempt from this disease, the cause of which is little understood, and which requires for treatment competent medical skill. It is mainly a disease of adult life. The treatment is both external and internal, the former being the more efficacious. Arsenic is a favorite in internal treatment, but its use is open to serious disadvantages. «Asiatic pills» is another arsenical preparation used in treating psoriasis. Salvarsan and neosalvarsan have proved ineffective. Hot baths at night, with a liberal use of soap, assist greatly in removing the scales. Sapo viridis is also used for this purpose. Consult Hutchins, M. B., 'Psoriasis' (in 'Reference Handbook of the Medical Sciences,' Vol. VII, New York 1916).

PSOVIE, or **BORZOI.** See GREYHOUND.

PSYCHE, sī'kē (Greek ψυχή, meaning breath, soul, life), in Greek mythology, a beautiful maiden regarded as an allegorical personification of the human soul. In a version of her story given by Apuleius in 'The Golden Ass' she is the daughter of a king and far outshines in loveliness her two elder sisters. Men take her for Venus herself and pay her the homage due to the goddess. In anger Venus directs Cupid to inspire Psyche with love for some unworthy wretch, but Cupid himself falls in love with Psyche. Meantime her father consults the oracle of Apollo regarding his daughter's marriage, and is commanded to convey her to the summit of a mountain and there leave her, for she is the destined bride of a monster dragon feared by gods and men. Sorrowfully he obeys, but when Psyche is left alone she is wafted by Zephyr to the palace of Cupid who visits her every night and departs unknown before morning. She is warned by her lover never to seek to know who he is, and no break would have occurred to her happiness had she not allowed her jealous sisters whom she admitted to her confidence to half persuade her that she held a hideous monster in her arms. One night while Cupid slept she came with a lamp to see him and in her astonishment and joy at beholding the most beautiful of the gods she lets fall a drop of heated oil upon his shoulder. Cupid awakes, reproaches Psyche for her suspicions, and leaves her. After trying in vain to drown herself, Psyche wanders from place to place seeking her beloved till she comes to the temple of Venus. Having Psyche at last in her power Venus treats her as a slave and imposes menial tasks, under which the maid would sink but for secret help obtained from Cupid. At length Venus orders Psyche to descend to the realm of shadows and bring away Proserpine's box of cosmetics. She succeeds in the adventure, but on opening the box is assailed by a deadly vapor issuing therefrom and perishes. Cupid now reappears, touches her with an arrow and restores her to life. Venus is reconciled, and Jupiter places Psyche among the immortals. Her marriage to Cupid is celebrated with great festivities, while her envious sisters cast themselve from a precipice. The story, as the name implies, doubtless was an adaptation of, and possibly was founded upon, the theory of the pre-existence of the soul, its suffering in this life, and then final redemption. Various phases of the story are to be found in early Greek and Roman art, dating even from the 2d century B.C., Psyche being represented as a delicate maiden with butterfly wings. Consult a translation of Apuleius' story in Walter Pater's 'Marius the Epicurean' (London 1885; new ed., New York

1902); and poetical versions of the tale in Morris' 'Cupid and Psyche' in 'The Earthly Paradise'; and Bridges, 'Eros and Psyche'; Conze, 'De Psyches imaginibus quibusdam' (Berlin 1855); Rohde, E., 'Psyche' (1894).

PSYCHIATRY, that branch of medicine which deals with diseases of the mind. Historically while mental diseases have always been recognized, they have often been thought to be of divine or diabolical origin and their consideration has been hopelessly entangled with religion and with metaphysical speculation. Even after mental diseases came to be recognized as the legitimate occupation of medicine their study was for a long time confined to the more serious varieties, collected under the caption «insanity,» which were found only in the asylums, and correspondingly the study of these patients and their illnesses became a distinct specialty of the asylum physicians (alienists). The practice of mental medicine in this restricted field tended for a long time to be little more than the custodial, albeit kindly care, of the seriously ill of mind. The great mass of practitioners of medicine had little or no interest in the subject. During the asylum period in the history of psychiatry very little was accomplished in the way of the scientific development of this branch of medicine. Its very isolation operated to prevent its growth and when finally progress did gain access to the asylum it was more occupied with humanitarian than with more strictly scientific problems. Then, too, the sciences upon the basis of which a firm foundation for psychiatry could be laid were not far enough advanced to warrant much progress. The science of psychology was honeycombed with metaphysical speculations and has only come to a systematic effort at an experimental elaboration of its data during the past generation. As a result of these conditions the early history of psychiatry is a history of more or less crude speculations, classifications and descriptions. Little was suspected of underlying causes and metaphysical discussions of the relation of mind and body effectually prevented all practical considerations of human behavior.

Present-day psychiatry has been made possible by the advances which have been made in the sciences upon which it rests, particularly by the advances in psychology, or more particularly that department of psychology which deals with abnormal mental reactions, namely psychopathology. A better understanding of the nature of mind and its position in the general evolutional scheme has made it evident that mental disease is the psychological manifestation of difficulties and defects of adjustment due either to causes operating within (endogenous) or from without (exogenous). Psychiatry thus becomes concerned with discovering these causes and makes a therapeutic approach to the problem presented by the symptoms of mental diseases by attempting to secure a better adjustment by removing the causes, avoiding their operation, or effecting some compromise solution. Inasmuch as defects of adjustment of some sort are present in practically every one, psychiatry has come to deal with all problems of mental health and not only the severe types of maladaptation found in the hospitals for the insane. Its therapeutic armamentarium includes not only all of the mechanical (surgery) and chemical (drug) methods of general medicine, but psychological methods (psychotherapy) as well as efforts at social rehabilitation and readjustment. It therefore includes the whole field of mental medicine, reaching into the field of social adaptation as a very important point of its domain and including, on the preventive side, the problems of mental hygiene.

To particularize the more important fields in which psychiatry has become important in recent years. In the first place there is of course the field of the so-called insanities or the frank psychoses such as we see in the hospitals for the insane. This field has been greatly broadened of late by appealing to patients to seek the assistance of the hospital before becoming seriously ill and availing themselves of the hospital's help after recovery to re-establish themselves socially. Then there is the immense field of the defective including the problems of the idiot and imbecile; the backward child in the school; and the innumerable problems of social maladaptation which have their roots in defectiveness such as many of the problems of prostitution, criminality and poverty. The whole field of criminology belongs essentially in the domain of psychopathology and thus comes within the practice of mental medicine-psychiatry. The most important field of modern psychiatry is perhaps the neuroses and psychoneuroses, which include those conditions known as hysteria, neurasthenia, obsessions, doubts, fears, impulses, etc. The persons who manifest this group of symptoms are not infrequently well endowed mentally, but their efficiency is greatly impaired by their illness. They can now be greatly helped by appropriate psychotherapeutic treatment. A study of these conditions has shown so clearly the conditions from which they grow that a further advance in preventive medicine along these lines will project the findings of psychiatry upon the problems of education and in fact the whole great group of problems involved in successful living. The principles which are found applicable to all these various abnormal conditions are as truly applicable to transient mental disturbances in quite normal people such for example as various types of nervousness, unhappiness or difficulties of adjustment dependent upon some character trait. The differences between the normal and the abnormal mind is only one of degree so that the field of psychiatry has now broadened to include what but a short time ago would have been considered the normal but where minor maladjustments prevent the fullest efficiency.

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PSYCHIATRY AND WAR. In harmony with the general fact that it is man's mind that receives last consideration in questions of health it has taken until the present war for any real appreciation of the incidence of mental disease in the military forces to get recognition. The Russians in the Russo-Japanese War had a regular organized service for caring for the mentally ill, removing them from the front and taking them back to the hospitals at Moscow and Saint Petersburg, but it has remained for the present war to develop a real comprehensive appreciation of the nature of the problems involved. The first of these problems, namely the examination of recruits for the purpose of eliminating the mentally defective or otherwise affected individuals who would probably not be able to stand the stresses of actual conflict, has been developed more elaborately in this country than in the European countries, probably for the obvious reason in America the man power has not been so severely taxed, for when it is experience teaches that all methods of examination which result in the elimination of recruits are looked upon with progressingly less favor.

The general plan in dealing with mental illness in the American army is broadly as follows: first, a weeding out of defective and otherwise mentally abnormal individuals in the various camps, the establishment in connection with the various hospitals, particularly the large base hospitals, of psychiatric wards in charge of a competent psychiatrist and assistants, with a detail of nurses who have had experience in institutions for the care of the mentally ill. The mental cases thus in the large base hospitals receive their proper classification and therefore treatment as do other varieties of illnesses and injuries. Coupled with this fundamental organization there is an effort to segregate the mental case as soon as possible back of the firing line and to place him under treatment at the earliest possible moment. Psychiatric departments therefore naturally took their place alongside of other departments in the great hospitals for the American troops on the other side. In these divisions of the hospital the mentally ill received prompt treatment, the object being to deal with minor mental ailments promptly before they have become aggravated or chronic with the immediate object of getting the soldier back into service and avoiding the necessity of invaliding him home.

The present war has developed no new forms of mental disease. The particular delusions or hallucinatory experiences of the mentally ill naturally vary and take their material from the immediate surroundings. Aside from this the pictures of mental illness are the same as we are accustomed to see in civil life. The one overwhelming feature, however, which distinguishes the mental cases in this war is the prevalence of the neuroses, grouped together under the somewhat misleading and general term "shell shock." These neuroses seem to offer nothing particularly different from those that are seen in civil life, but are very numerous and a source of serious concern because of that fact. It is because many of these neuroses can be dealt with effectively, if gotten at early, that the scheme was to deal with them in hospitals on the other side. All of the chronic cases such as we see every day in our State hospitals and patients suffering from neuroses in whom the neurosis has become a pretty well-fixed affair will ultimately be invalided home and distributed on landing to specially constructed psychiatric wards, for the most part along the Atlantic Coast. From here they will be further distributed, some to State hospitals, some to the Government Hospital for the Insane — Saint Elizabeth's Hospital, in Washington, D. C., others to their friends and relatives.

The United States government will normally be responsible for these soldiers whose mental illness is directly traceable to the performance of their duties as soldiers. Naturally there will be a number of cases whose mental illness will be traceable to conditions which arose before they went into the service and were only discovered by the army. For these the United States will not be responsible. For the others, however, they will be, and the treatment of their mental condition will be a part of the large problem of the rehabilitation of the soldier when he returns shattered in mind and body from the war.

The immediate dealing with mental disease as generally recognized merges imperceptibly in several directions into the handling of various psychological situations which are recognized as being more or less abnormal. For example, in the rehabilitation of the injured and crippled soldier the psychological problems involved are most important and strike at the very foundations of the capacity for social adjustment. The crippled hero is not easily going to be inducted back to the hum-drum drudgery of the shops, nor is the employer easily going to be induced to hire a man who is severely crippled when he can just as easily get one who is not. The method of approach to these problems is psychological and in the case of the attitude of the soldier at least approaches, if it does not overstep, the limits of the normal.

In the same way numerous problems of defective psychological adjustment are arising in other directions. The highly trained, exquisitely sensitive flying men not only require a most careful and frequent sizing up of their physical resources, but it is beginning to be appreciated that they need the same kind of attention to their psychological resources and that perhaps a number of the accidents which happened in this branch of the service could have been avoided if this sizing up had been effectively done.

The psychological examination of recruits in large numbers introduced methods of sifting out defectives, but in addition to that it introduced methods which serve as measuring rods of efficiency. So that the hundreds of thousands of men who went into the service were measured in a way in which the population has never before been measured, with a result that methods are growing up which will serve more and more effectively to fit the individual to his job and also to pick out all manner of defects in the usual way of accomplishing this end.

The army is proving to be a great piece of efficiency machinery which demands certain pretty-well defined results and the line officers and the scientific men are working side by side, not for the sole purpose of weeding out the unfit or treating those who have become ill but with the added purpose of saving those that are misfits by making readjustments in their relations to the army machine either by transfers to other branches of the service, certain re-educational adaptations, or what not, which will render it possible for them to stay in the army and render good service in accordance with their capacities. Undoubtedly this great experience will be projected into the civil population after the war with the result that the problems of psychiatry, of mental illness, or social adjustability, will all be viewed in a much broader aspect and be much more wisely dealt with.

In addition to the above definite efforts are being made along other lines which at first perhaps seem to have no relation to mental illness but which really are closely related thereto, specifically the efforts in the direction of social hygiene, namely, the prevention of the high incidence of venereal disease which is so usual in military organizations. When it is appreciated that syphilis is responsible for upwards of 10 per cent of the cases of mental disease confined in our public institutions it will be also appreciated how efforts at limiting the incidence of this disease go directly to the root of the problem of the prevention of mental disease. A co-ordinate activity addressed in the same direction is the effort at providing adequate recreation and suitable occupation during the leisure hours for soldiers in camp. These are all efforts in the direction of mental hygiene and as such are addressed to the preservation of mental health and the prevention of mental illness and, therefore, come within the scope of psychiatry in its widest meaning. The prevention of any material percentage of venereal disease in the military organization by such methods as are addressed directly or indirectly to their prevention or cure will ultimately have an enormous effect upon the general health throughout the country when the soldiers return to civil life and to their various pursuits. Ordinarily they bring back into civil life an enormous amount of potential suffering and disaster in the shape of venereal infection, an unknown portion of which must necessarily result in mental illness of themselves and others. Venereal prophylaxis and methods of mental hygiene will serve to curtail this danger very materially.

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PSYCHICAL RESEARCH. In its technical sense psychical research refers to objects and methods of investigation employed by The Society of Psychical Research, which was founded in England in 1882. The function of this society is set forth in the following announcement: "It has been widely felt that the present is an opportune time for making an organized and systematic attempt to investigate that large group of debatable phenomena designated by such terms as mesmeric, psychical and spiritualistic. From the recorded testimony of many competent witnesses, past and present, including observations recently made by scientific men of eminence in various countries, there appears to be, amidst much illusion and deception, an important body of remarkable phenomena, which are *prima facie* inexplicable on any generally recognized hypothesis, and which, if incontestably established, would be of the highest possible value. The task of examining such residual phenomena has often been undertaken by individual effort, but never hitherto by a scientific society organized on a sufficiently broad basis." The society's membership has included the names of Henry Sidgwick (the first president), A. J. Balfour, W. F. Barrett, Balfour Stewart, Edmund Gurney, Frederic W. H. Myers, Oliver Lodge, William Crookes, Lord Rayleigh and Alfred Russell Wallace. In 1884 an American Society for Psychical Research was established and later (1890) incorporated with the British society. In 1906 the societies again separated. Similar organizations have been formed in Germany and other countries. The records of the English society fill many volumes of Proceedings and Journals. Besides these official reports, individual members have published numerous works on psychical research. The investigations of the society have been directed by six principal committees to whom the following tasks were severally assigned in 1882: (1) An examination of the nature and extent of any influence which may be exerted by one mind upon another, apart from any generally recognized mode of perception. (2) The study of hypnosis, trance, clairvoyance and other allied phenomena. (3) A critical revision of Reichenbach's researches with certain organizations called "sensitive." (4) An investigation into apparitions and haunted houses. (5) An inquiry into the various physical phenomena commonly called spiritualistic; with an attempt to discover their causes and general laws. (6) The collection and collation of existing materials bearing on the history of these subjects. In brief, the work of the committees has covered the subjects of telepathy, hypnosis, trance, automatisms, "magnetic sensations," apparitions and "spiritualistic manifestations." Three principal methods have been employed by the committees and by individual members of the society: (1) the examination of accumulated evidence and of current cases; (2) experimental investigation, and (3) statistical treatment. The first of these methods has been used widely in the study of apparitions and alleged spiritualistic phenomena — ghost stories have been collected and noted mediums examined; the second, in hypnosis, in tests of Reichenbach's claims and in the collection of evidence for telepathy; and the third, in interpreting extensive data regarding apparitions and hallucinations.

The results obtained by the several committees are quite unequal. Investigations into the «magnetic sense,» into clairvoyance, haunted houses and the grosser physical manifestations of «spirits» — that is, raps, table-tipping, slate-writing, levitation and «materializations» — have turned out, on the whole, negatively. Many instances of fraud, of defective observation and of involuntary deception have been brought to light. Hypnosis and allied states have been investigated, not so much for their own sake as for the study of telepathy and of subconscious states. The work of the society may be said to centre in the question of telepathy and the existence of mind independently of the body. In order to secure evidence touching both these matters the Society for Psychical Research instituted, in the years 1889–92, an extensive census on hallucinations. Answers to the number of 17,000 were returned to the following question: Have you ever, when believing yourself to be completely awake, had a vivid impression of seeing or being touched by a living being or inanimate object, or of hearing a voice; which impression, so far as you could discover, was not due to any external physical cause? About one-tenth (1,684) of the answers were affirmative, and of this number 80 were «death-coincidences; that is, cases of recognized apparitions occurring within 12 hours of the death of the person represented, the death being unknown to the percipient at the time.» The committee in charge of the census draws the conclusion that «between deaths and apparitions of the dying person a connection exists which is not due to chance alone.» In the last few years the society has devoted much attention to the study of trance states as produced in certain persons called «sensitives.» This study is said to furnish evidence of telepathy. It is considered by some members of the society to be the most fruitful subject for further investigation.

The achievements of psychical research are difficult to estimate. The movement has undoubtedly contributed to knowledge of the facts investigated and the conditions under which these facts arise. It has also performed a service to mankind in its critical examination both into the validity of human testimony and into certain unreliable factors in the motives to the establishment of belief. The evidence offered for a telepathic agency and for the independent existence of mind apart from cerebral functions is considered in some quarters as amounting to proof; in others, as lending probability only to these hypotheses; and, by many educated persons, as entirely lacking in cogency. It is of importance to notice, in this connection, that belief in the factual basis of telepathy — that is, in the influence of one mind upon another where no physical medium has yet been discovered — does not necessarily imply a theory regarding the nature of and the conditions underlying such influence. Various hypotheses intended to explain the facts in question have been offered, but no one of them has as yet found general acceptance.

Psychical research, in so far as it examines conscious experience, sustains a somewhat intimate relation to psychology; although it is more closely allied to abnormal than to general psychology. It should be pointed out, however, that its aims and in some respects its methods also bring it into closer relation to certain practical aspects of life and to philosophy than to psychology.

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PSYCHIDÆ, a family of moths (q.v.).

PSYCHOANALYSIS is primarily a system or method of medical practice which aims to interpret and treat various visceral, nervous and mental disorders through their most fundamental causes in the nature and life of the individual. These causes are discovered and a readjustment of the factors they represent is effected through the means which the name suggests, an analysis of the psyche or mind. This name was chosen by Sigmund Freud of Vienna to express the nature of his work when he elaborated this method in his experience with hysteria and other psychoneuroses. It was through his experience working with Breuer in hypnotizing such patients that he came to a realization of the existence and continued activity of certain factors or groups of factors belonging to the mental life, which survived in the unconscious when consciousness no longer remembered their existence. He found that the bringing of these hidden factors into conscious memory or into free activity through hypnosis and the obtaining thus of an emotional reaction to them, even after a long period of years in which they were consciously forgotten, gave relief from various physical and mental symptoms. As he proceeded with his work he came to realize that hypnosis was by no means a completely satisfactory method of procedure. Many patients could not submit to hypnosis; the results were not always sufficiently permanent as it was more or less difficult for consciousness to retain the effect of the abreaction of affect or emotion which had been obtained during the hypnotic state. He felt that there should be more co-operation between the patient and the physician, which could be better realized and more effectively handled if the patient retained consciousness and brought his own reason also to bear upon the problems and the facts involved. This would be a slower but a more effective method and one which would have an application to a larger class of people. The method consists briefly in a series of interviews extending over varying periods of time owing to the mass of mental material to be examined and to the emotional obstructions which have to be patiently understood and overcome as this long buried and highly emotional material is brought to light. The working principles of psychoanalysis lie in the acceptance of an unconscious side to the mental or psychic life, which forms the greater part of any individual life. This unconscious material should naturally be the reserve material conserved from the past lying ready for continual passage over into the superficial conscious life to furnish material for thought and action. It should be the storehouse of all past experience and of the sum of feeling and tendency which constitute individual character. The way into consciousness should be sufficiently open so that such material may be selectively chosen according to practical and creative needs and yet so well guarded that superfluous material shall not thrust itself distractingly into the field of thought and action. Therefore a certain amount of repression is necessary to hold the psychic material in useful control.

The ideas and the feelings which belong to past experience and which form the mental content of each individual, however, have not always established themselves in the past in proper proportion and relation to the facts of life and toward each other. There is a good deal of exaggeration, disproportion and distortion in any life and an excess of these things, from the point of view of psychoanalysis, constitutes a neurosis. Here repression has become excessive because emphasis was laid upon certain factors probably in infancy, which would thrust into undue attention certain things which society and the individual's own social, ethical and æsthetic sense would tend to banish. Yet these factors had not been properly attended to before repression occurred. Their exaggerated emotional importance had not been relieved by a reaction to them, «abreaction» Freud has called it, at the time when they were established. Therefore it is the work of psychoanalysis to search the unconscious for the existence of such hidden factors and bring them out through an understanding and interpretation of them and a recognition of their actual place in the economy of the child's and the adult's growth and development. The discovery of these, their correct appraisal and then the readjustment of them to the claims of reality and the demands of the social environment in which the individual has to live must be made by the patient with the guidance and interpretative aid of the psychoanalyst. The searching of the unconscious takes place chiefly through the interpretation of the dreams of the night, when according to the theory of psychoanalysis the unconscious emotional nature, which manifests itself as wish, speaks most freely, conscious control being largely withdrawn. Enough of the latter is present, at least at the moment of waking and remembering the dream, to cause the latter to take a distorted form, so that the wish, the pure expression of the unconscious impulses, is much disguised. For this reason psychoanalysis in the use of the dream is dependent further upon the free associations which are called forth by relating and thinking over the dream. These too are imperfect and fragmentary but, because they belong in the endless chain of mental associations, disclose more and more of the mental background out of which the dream arose. It is the endeavor of psychoanalysis to watch these, follow them patiently as they draw themselves together and gather insight and interpretation from them. Daydreams are of the same nature as the dreams of the night, only a little more under control of conscious intellectual thought. From the same source are certain sudden acts, facial expressions, attitudes, mistakes in speaking, sudden forgettings, spontaneous displays of feeling. They all arise from the unconscious depth of the mental life to appear on the conscious surface. These are also watched and utilized in psychoanalysis for the discovery and understanding of the hidden mental life.

The cure in psychoanalysis is no mystery but occurs through the simple understanding of the hidden forces and desires within one, with the strange and unsocial or obsolete ideas which have surrounded these from earlier stages of individual development and which analogous to earlier or even more primitive periods of racial history. When the real nature of this inner life is realized and its emotional dynamic force understood for the first time, it follows naturally that the life is reconstructed along new lines of usefulness and health. Yet because of the depth and the complexity of this inner psychic life such understanding and readjustment are not arrived at quickly or easily. For this reason psychoanalysis necessarily has to pursue a pathway of serious duty, profound psychology and extensive knowledge of human life in its present extent as represented in all peoples and all varieties of individual and in the past history of men and the gradual development of the race as well. It must learn to know the history of human striving with these same emotions which belong to all ages, and to know the special manifestations of these which belong to any one age of history or evolution. For traces of all these are found in the psychic recapitulation of each individual and any one of these may help to understand any particular mental fixation which may lie as a basic cause of a neurosis.

Psychoanalysis finds its particular field in the psychoneuroses or borderland cases, so-called «nervous» disorders of a mental rather than a purely physical anatomical type. Such cases are particularly fitted for the intellectual co-operation which the method entails and they are also in particular need of a method which combines reason and a frank recognition of the feeling life. Strictly medical procedures fail to reach them and other forms of so-called mental healing do not enter as psychoanalysis does into the detailed investigation of individual difficulties and bring them one by one into the clear light of reason. A sweeping and revolutionizing «faith» is supplanted here by personal and patient examination and interpretation. Actual psychoses, pronounced mental derangements, are not always amenable to psychoanalytic treatment yet much has already been done here when the more lucid intervals or the still remaining reason of a patient could be utilized for co-operation. Psychoanalysis has proved itself invaluable in the understanding of such mental disorder and appreciation of the emotional conflict involved with an interpretation of the hitherto meaningless ideas and behavior of such patients. The field opens here for mental prophylaxis through psychoanalysis. A promising field is opening up for the application of the principles of psychoanalysis to various physical diseases since on the side both of psychology and of physiology new information is continually being discovered and reported in regard to the close interrelation between mental factors and physical manifestations. In its prophylactic function psychoanalysis bids fair to become an important pedagogical agent. It has shown through its medical work the importance for the health and success of later life of the right attitudes in childhood and of a clearer knowledge on the part of the child of the mental life which he conceals within him. Its province certainly lies in the future in better instruction for children in regard to their own mental and physical lives and better understanding and adjustment of the problems which arise in the course of their development and adjustment to the world in which they are to live. Though psychoanalysis began as a form of medical practice and its chief service lies in this sphere, still from its nature it is bound to find its way into other territories. In the first place it has done much to reveal the close connection existing between the province of medicine, that is, health and disease, and every other interest of life. Then in its strictly medical application it has been shown how dependent it is upon all forms of human effort and interest for a complete understanding of the human problems and human strivings that make up the mental life of the patient. All this has tended to push it on into fields of wider interest. The principles of the unconscious mental life, preservation of the mentality of the past and present, the unconscious as the dynamic source of endeavor, as the fountain from which human creativeness must draw, give it also a peculiar interpretative value in all forms of artistic creation, a special power of evaluating these and a similar interest in the study of all forms of history, art, religion, language, material advance, in short of all human activity. It has a practical application in the discovery of latent powers, the inhibitions and hindrances with which these are encrusted and, therefore, the spread of its principles of investigation and understanding should form the true basis of a practical psychology of efficiency.

The history of psychoanalysis as a movement dates from Freud's development of it in the last decade of the 19th century (1893) as he modified his own and Breuer's earlier treatment of hysteria. He worked privately with a sincere conviction of the reasonableness of his method and its peculiar applicability to the psychoneuroses. His expectations were modest. Its radical character brought him opposition but he was content to work alone waiting for time to prove the correctness of his theories and the usefulness of the method. Soon, however, he realized a growing interest about him. Other physicians gathered around him and interest began to be manifested in the wider application of psychoanalysis, outside the field of medicine. Two of the early followers of Freud were Bleuler and Jung who carried the teachings of psychoanalysis to Zürich and did much to disseminate them throughout the world. Although they have since altered to some extent the application of psychoanalysis to medical practice, they stand essentially for the original promulgation of these.

Psychoanalysis spread through other adherents into Germany, Russia, Holland, France, Italy and other countries of Europe though not to an equal extent in all. England has been but slowly receptive, though experience in the World War has given it marked impetus there. The United States has proved itself especially hospitable to psychoanalysis. It was first introduced there chiefly by Drs. A. A. Brill and E. Jones and in 1909 by Freud himself when he delivered a series of lectures at Clark University and psychoanalysis entered under the official sanction of G. Stanley Hall. Since then it has flourished chiefly in medical circles. These have been small but gradually a general acceptance of it is making its way into the medical body. It is represented officially by the American Psychoanalytic Association. One American periodical is devoted to the subject, the *Psychoanalytic Review,* and a wide literature has sprung up and is being constantly increased. This consists of translations of Freud's works, some of which pertain strictly to medical problems, some of which are a thoughtful application of psychoanalysis to other spheres of interest. Translations of other foreign writers on the subject are appearing from time to time. Original articles appear in increasing numbers in various medical and scientific journals together with medical reports of actual psychoanalytic work. Various books on psychoanalysis, some popular in presentation, others more strictly technical, have appeared from time to time. It has been inevitable that a subject which so closely appeals to deeply laid human interests should fall victim to a great deal of misunderstanding and bitter reproach on the one hand and become the prey of a flippant superficial interest in whatever is new and emotionally appealing on the other. Its true import and its actual service to the health and well being of the individual and society are matters for the test of time and for further development in meeting these individual and social needs. The application of the principles and methods of psychoanalysis to nervous and mental disorder resulting from the war gave a new impetus toward its acceptance and interest in its real significance in the United States as well as abroad. Consult Jelliffe, S. E., 'Technique of Psychoanalysis,' and Jones, 'Papers on Psychoanalysis'; Lay, W., 'Man's Unconscious Conflict.'

SMITH ELY JELLIFFE, M.D.

PSYCHOLOGICAL APPARATUS. The object of the psychological laboratory is, in brief, to standardize the conditions of introspection (see PSYCHOLOGY); to make it possible that psychological observations shall be taken in the most favorable circumstances, so that they may be repeated (by the same or by other observers), isolated and varied. It is only under these experimental conditions that the results of introspection can lay claim to universal validity. The single, hap-hazard observation, made under all the distractions of ordinary life, is worth as little in psychology as it would be in physics or physiology. Hence it was nothing less than a revolution in psychology when W. Wundt founded in 1879, at Leipzig, the first psychological laboratory that the world had known. Wundt's example was quickly followed in America by G. S. Hall, who founded a laboratory in 1881 at the Johns Hopkins University. At the present time all the more important seats of learning in Germany and the United States are equipped with psychological laboratories, while there are a large number distributed through the other civilized countries of the world.

To give an idea of the problems with which the experimental psychologist is busied, we may mention some of Wundt's early apparatus and the questions which he hoped to solve by their aid. In 1861 Wundt devised the *complication pendulum* (Fig. 1) in order to determine the behavior of attention under the influence of two simultaneous stimuli. Suppose that I am subjected, at one and the same time, to a sight and a sound. Do I hear and see together? Do I see before I hear or hear before I see? The question was of great practical importance, since it was involved in the "eye and ear" method then in vogue for a certain type of astronomical observations. Its general psychological importance is obvious. The instrument now "consists of a large, heavy, wooden pendulum. The bulb carries a pointer, which as the pendulum swings passes over a circular scale. Near the point of rotation *m* there is fixed to the stem a horizontal metal bar *ss*. A movable vertical standard *h* has attached to it a metal spring, also in the horizontal line. The spring is fixed in such a way that the bar *ss* in passing by produces a short single click, the end of the bar and the point of the spring just touching each other, while the shock is so slight that the course of the heavy pendulum is not noticeably affected. By watching the course of the pointer attached to the bulb of the pendulum, while the upper part of the instrument remains concealed, we can determine at what point of its passage to or fro the click of the spring takes place. For example, if the pointer appears to be at *e'* at the moment of the sound, the bar *ss* will be in the position *ab*, and this will mean that the passage is put too early. If the pointer seemed to be at *e"*, the bar would be in the position *cd*, and this would mean that the passage was put too late. If we know the duration and amplitude of the pendular vibration and measure the angular difference between *e'* or *e"* and the actual point at which the bar *ss* comes in contact with the spring, we can easily calculate the interval between the giving of the sound and its apperception." The instrument has been gradually refined and its scope extended until it now has the form shown in Fig. 2.

Another of Wundt's early experiments was made to determine the range of consciousness for auditory impressions. I hear a number of similar sounds; say, of metronome strokes. How large a group can I keep in mind at once? I must not count; for that would mean a separate attention and a verbal association to every sound. Suppose that a group of 20 strokes, marked off by bell-tones, is followed by a group of 21 marked off in the same way. Do the two groups appear the same or can I tell that they are of different lengths? This question was answered by Wundt by aid of the instruments shown in Fig. 3. The metronome *M* gave the series of sounds, and the limits of the series were indicated by the bell *G*. Fig. 4 shows a later and better instrument for the determination of the range of consciousness to visual impressions.

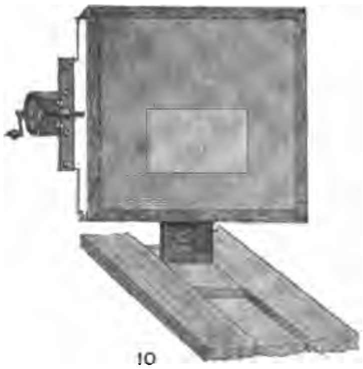
A third experiment concerns our judgment of time intervals. A wheel, driven by clockwork, carries a pointer which clicks against contact strips arranged along the circumference. The instrument is shown in Fig. 5. It is possible to give two clicks and to let the observer arrest the clock after an interval which seems to him to be equal to the interval that separates the clicks; or to sound three clicks — two continuous intervals — and to let the observer judge of the equality or inequality of the times enclosed by them; or, finally, to sound four clicks — two intervals with a pause between — and to see how the observer's judgment of equality or inequality of the times varies with variation of this intervening pause. A newer and more elaborate instrument is shown in Fig. 6.

A fourth experiment, known as the "simple reaction experiment," is important for the psychological analysis of attention and action. A simple stimulus (a flash of light or the sound of a ball falling on a wooden plate) is given to the observer, and he replies to it by making some simple movement, which has been determined beforehand. Instruments are so arranged that the giving of the stimulus starts an electric clock, and the responsive movement stops it: so that the time elapsing between stimulus and answer to stimulus can be exactly measured. It is clear that the "reaction" experiment reproduces for us, in an elementary form, the consciousness of voluntary action. We see or hear something and act upon it. Since the experiment can be repeated as often as necessary it is possible, by means of it, to subject the action consciousness to minute and refined introspective examination. We find, further, that the time of reaction varies according as the attention is directed predominantly to the stimulus or to the reaction movement, according as the stimulus attended to is to be apprehended in its qualitative or intensive character, according as the observer is fresh or fatigued, etc. The apparatus employed are shown in Fig. 7. The falling of the ball upon the plate in *F* starts the electric clock *H*, whose unit is 1/1000 second. Pressure of the finger upon the key *U* stops the clock; this pressure constitutes the movement of reaction. *C* is a hammer, whose time of fall is constant; it serves to check the accuracy of the clock (chronoscope). The other instruments figured are subsidiary. Fig. 8 shows an elaborate apparatus for giving visual stimuli in reaction work.

The reaction experiment may be adapted to more complex consciousness. Thus the observer may be told that he will hear either a noise or a tone; he is not to move until he is sure of the stimulus given (discrimination reaction). Or he may be told that he will hear either a noise or a tone, and that he is to react to noise with the right and to tone with the left hand (choice reaction). Or again, the stimulus may be a spoken word, to which the observer reacts by speaking a second word which he has associated to the stimulus. Instruments have been devised which meet the requirements of these and of many other variations of the experimental procedure.

The four experiments thus far discussed are typical of the problems with which experimental psychology set out. In a well-equipped modern laboratory the apparatus fall into three main groups: demonstration instruments, with which

PSYCHOLOGICAL APPARATUS



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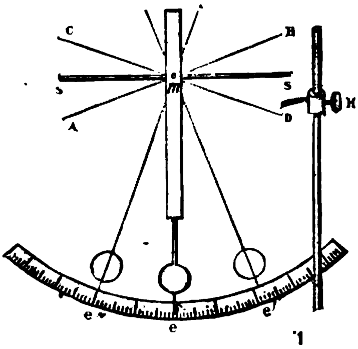

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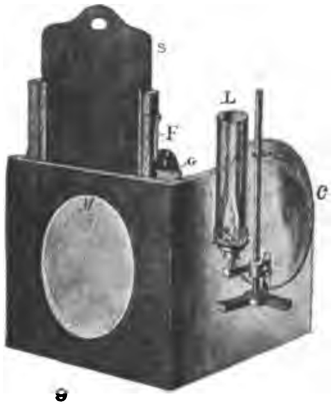

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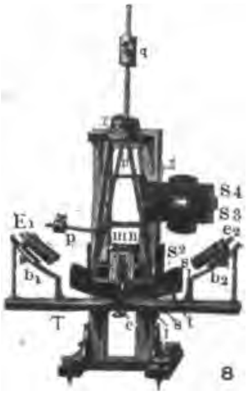

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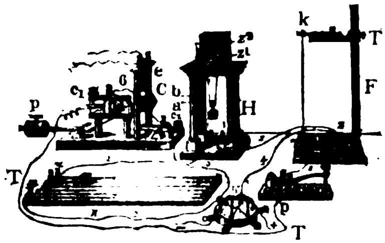

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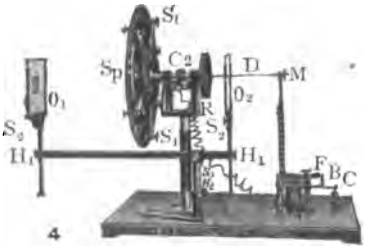

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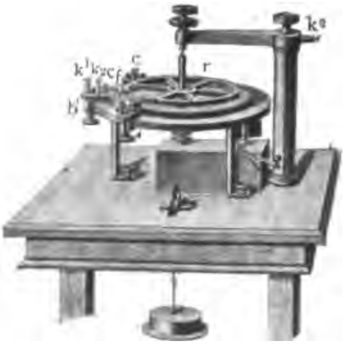

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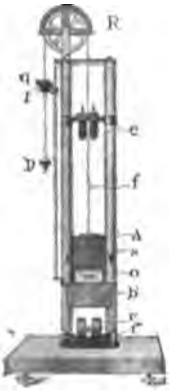

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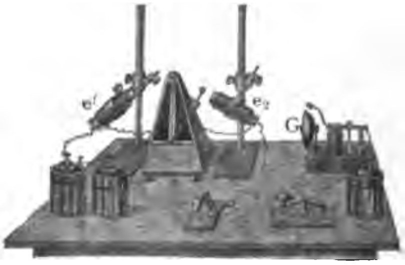

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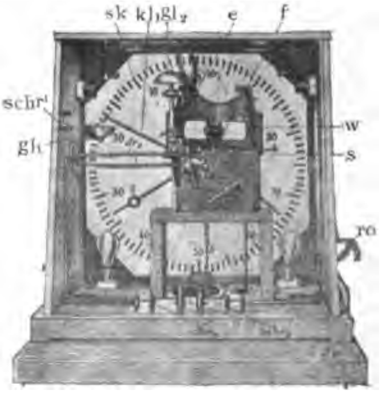

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For explanation see article

experiments may be performed upon the lecturer's desk; class instruments, which are put into the hands of undergraduate students for training and drill-work; and research instruments, the materials of investigation by graduate students and by the instructing staff. As an illustration of the demonstration group we may cite Wundt's apparatus for negative after-images of vision (Fig. 9). A large circle of colored glass, placed directly behind a ground glass plate and illuminated by a powerful lamp, is fixated by the members of the class for some 30 seconds. At the end of this time a screen is dropped between colored glass and lamp. The ground glass surface then appears, as a light gray; and upon this gray background the after-image of the colored stimulus develops. As an illustration of the second group we may mention an apparatus for the determination of the *minimum visible* of distance (Fig. 10). Two black points appear upon a white cardboard surface. The one point is fixed; it is painted upon the back surface of a sheet of glass which covers the cardboard. The other, painted upon the cardboard background, can be moved to or from the fixed point by means of a micrometer screw (reading to 1/200 mm.) placed at the side of the frame. The problem is to determine the last separation of the points which (under given conditions of experimentation) can still be perceived by the observer. Finally, as an illustration of a recent research instrument, we may refer to the drop-tachistoscope for range of visual attention shown in Fig. 11 (see Fig. 4).

The range of psychological instruments is very wide. In the sphere of sensation we have apparatus for work on color mixture, contrast, adaptation, after-images, color blindness and the spatial distribution of the retinal sensitivity; for work on tonal fusion, beats, combination tones; for work on the sensations of pressure, warmth and cold, on the sensations of taste and smell and on the organic (muscular, articular, etc.) sensations. In the sphere of affection we have instruments which register exactly the bodily changes that accompany change in the affective disposition (pleasantness and unpleasantness): pulse recorders or sphygmographs, breathing recorders or pneumographs, volume recorders or plethysmographs and strength recorders, ergographs and dynamographs. In the sphere of attention we have instruments for measuring the duration and the range or span of the attentive state. In the sphere of perception we have, for example, all sorts of instruments for the analysis and synthesis of visual space perception: among them the familiar stereoscope and its converse, the pseudoscope; instruments for the measurement of the various types of optical illusion, and so on. Memory and association have a whole laboratory of apparatus of their own; one of these, which exposes at regular intervals a series of words or syllables to be memorized, is shown in Fig. 12.

It should be clear, even from this hasty and imperfect survey, that the arrangement and furnishing of a modern psychological laboratory is a very complicated matter. There must be a large lecture-room, fitted with all conveniences for desk demonstrations and class experiments. There must be a dark room for work in psychological optics, and an absolutely quiet room for work in psychological acoustics. There should be a special room, specially ventilated, for work on olfactory sensation and perception. There must be a series of fairly large and well-lighted rooms for the group work of undergraduate students. There must be a series of closet-rooms for the research students. There must be research laboratories for the instructing staff. There must be a workshop, or rather there should be two workshops — one in the general laboratory, in which the students themselves may assemble complicated pieces, and make the necessary modifications in existing instruments, and another sacred to the mechanician, who is an indispensable part of the staff of an adequate laboratory. Every new investigation — and experimental psychology presents far more novel problems than can be solved, at the present rate of work, in a human generation — demands its own new set of instruments. It must be confessed that, as things are, psychology is for the most part rather shabbily housed. The science of mind appeared on the scene later than the science of life and of inorganic nature; and, when it came, funds and buildings were very largely pre-empted. There are, however, some signs that it is coming to its rights in this regard; and the next 10 years should see a very considerable improvement in the material conditions under which experimental psychologists are called upon to work in colleges and universities.

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PSYCHOLOGICAL ASSOCIATION, American. See AMERICAN PSYCHOLOGICAL ASSOCIATION.

PSYCHOLOGICAL DETERMINISM. See DETERMINISM.

PSYCHOLOGICAL SCHOOL OF ECONOMICS. See ECONOMICS.

PSYCHOLOGY has been defined, from time immemorial, as the science of mind. This definition, which agrees well with the etymological meaning of the word "psychology," may be accepted by the modern psychologist, provided that its two terms ("science" and "mind") are themselves correctly defined. This is an important point: for it is clear that the terms of a definition must be mutually compatible. If we speak of a "science of mind," we must define the word "science" in such a way as to make it cover the field of mental phenomena, and we must define the word "mind" in such a way as to make it amenable to scientific treatment. To speak of a "science of mind" when one meant by "mind" something outside and beyond the reach of scientific method would be absurd.

The general characteristic of science is just its method. All science proceeds by observation; but the term science is not usually applied to any body of knowledge until it has reached the stage of experiment,— the stage, that is, at which its observations can be taken under standard conditions, can be repeated, isolated and varied at will. Further, the term science is usually reserved for classified and coherent knowledge; for experimental observations that can be grouped together, as illustrative of some natural law or uniformity. One of the tests of a science, from this point of view, is its capacity to predict, on the basis of natural law, what will happen, under given conditions, in the individual case. Yet again, the term science, in its strictest sense, is reserved for explanatory knowledge: the observations must not only be accurate, must not only fall into groups, under general laws, and thus render it possible to predict the outcome of new observations, but must also be linked with and referred to their own causes or conditions in the world at large. Experiment, uniformity and explanation,—these are the three tests which psychology must satisfy, if it is to rank as a science among the sciences.

Within the scope of these general requirements, the sciences are differentiated by differences of their subject matter. Now the subject matter of psychology is mind: not mind as popularly understood, perhaps, but mind which is accessible to experiment, mind whose uniformities we can discover, mind whose processes we can explain. Descartes, when he set to work to reconstitute philosophy, took his stand upon the proposition "I think." It is a long 250 years since Descartes gave his 'Discourse' to the world; and what, to him, was metaphysical speculation has now become an unquestioned belief of common sense. We all tend to look at mind as Descartes looked at it; we all tend to say "I think," and so to separate the "I," as active thinker, from the "thought" which is the result of the I's activity. Psychology cannot recognize this distinction. The datum for a psychology, if it is to be a scientific psychology, is rather "Thought goes on:" "there are processes of thought in the world." And so the subject matter of psychology is thought just as thought exists, thought looked at for its own sake and interest. Or rather, since mind is a wider term than thought, and covers the facts of feeling and of will as well as the facts of intellect, the subject matter of psychology is mental process: the whole tangle of thoughts, memories, fancies, feelings, emotions, resolves, desires, aspirations, that make up our mind as we look at it from moment to moment. The problem of psychology is to bring order into this chaos, to reduce the infinite variety of our immediate experience to a coherent and manageable system.

If it be asked how precisely this material differs from the material upon which other sciences are working, what is the criterion that differentiates the subject matter of psychology from the subject matter of physics, the reply is simple. Mental process, the material of psychology, is confined to the exeprience of a single individual; psychological experience is unshared experience. The universe of nature is common to all of us; the universe of mind is open but to one,— to each man his own. The laws of physics and of physiology take no account of the individual: sound is a certain motion of the air waves, digestion is a certain sequence of chemical changes; and the phenomena of sound and of digestion are treated abstractly, so that we can conceive of a deaf man as understanding acoustics, or of an anæsthetic patient as familiar with physiological chemistry. Psychology, on the other hand, deals with the sound as we hear it, with the hunger and thirst that we feel; and these experiences, however accurately we may express them in words, are, as experiences, incommunicable.

Two results follow from this peculiarity of psychological subject matter. The first is that the method of psychology differs from the methods of the physical sciences. All science demands observation, we have said; all exact science demands experiment. So far, then, all scientific method is one and the same. But the observations and experiments of physics and chemistry, physiology and zoology, are made upon material that is common scientific property; the observations and experiments of psychology are made upon private property, and, more than that, upon property which is inalienable. If we class the former all together as inspection, we may oppose the latter to them as introspection. In the physical sciences we look out upon a world that is shared by everyone alike; in psychology we look within, upon our personal world. From this difference in method it follows, in the second place, that the need of an experimental verification of results is more pressing in psychology than in any other department of science. If we cannot, in some way, transcend the intrinsic defect of introspection, its personal and individual character, we are likely to have as many psychologies as there are psychologists to introspect. In actual fact, the history of psychology records not a few cases of introspective deadlock,— of observation pitted against contrary observation. It was not until the introduction of the experimental method in psychology that this danger ceased to be serious.

"But," it may be asked, "is modern psychology really free from this danger? Are all psychologists always agreed? Are there not still schools of psychology?" To answer these questions we must distinguish a little. In principle, modern psychology *is* free from the danger of introspective deadlock. Divergent observations are still made, in plenty; but psychology herself furnishes the means of reconciling the divergence. Let us take an illustration from physics. Two competent observers may be analyzing a compound body by the spectroscopic method: the one may find the lines of a certain rare element, the other may be wholly unable to see these lines. Both analyses are published. We read them, and notice that they disagree. Do we at once lose confidence in the method? Not at all: we simply hold our judgment in suspense until further observations, by the same method, are forthcoming. We say that there must, in the one case or the other, have been some unsuspected source of error which vitiated the result; and we appeal to the method itself to indicate this source of error. More observations are made, with stricter regard to the conditions of the analysis; and presently we reach a final conclusion. It is precisely the same in psychology. Experimental introspection may yield conflicting results, as does experimental inspection. But we have merely to go on experimenting, and the true result will ultimately emerge. In principle, then, psychology has nothing to fear from this particular danger. On the other hand, it must be frankly admitted that there are many and various schools of psychology. Only, the points of disagreement are points that lie outside of psychology itself. Let us, again, take an illustration from the sciences of nature. Listen to a group of mathematicians discussing the character of the infinitesimal: to a group of physicists discussing the definition of energy: to a group of physiologists discussing the mechanics of life. To hear them, one would think that the status of their respective sciences was precarious in the extreme. Yet we all make use of the calculus; we build locomotives and power-plants and rely upon the balance and the thermometer; nay, we trust our actual lives to the surgeon and the physician. Moreover, the practical work of all these sciences goes on, and goes on with increasingly fruitful result, despite the theoretical difficulties that lie behind it. So it is in psychology. Psychologists are apt to dispute the greater and more fundamental issues that lie before and after their science: these issues will always be disputed, so far as we can see, while human nature remains human nature, and men are individualized by training and temperament to envisage the universe from different points of view. In a general sketch, like the present, such differences must be baldly and plainly stated. The reader must, therefore, be warned not to lay too much stress upon them. The extreme opinions of opposing schools shade into one another by imperceptible gradations. And however extreme they may be, they have little if any bearing upon the practical work, the teaching and investigation, of mental science.

The Problem of Psychology.— We said above that the problem of a scientific psychology is to bring order into the chaos of the immediate experience. We may now note that, chaotic as this experience is, it neverthless is something more than chaos; it groups itself, roughly and indefinitely, no doubt, but still quite noticeably. If we reserve the wider term «mind» for the sum total of mental processes running their course between birth and death, we may say, first of all, that mind splits up into «consciousnesses.» A consciousness is a mental present; a mind that has a temporal «now» stamped upon it; a bit of mind that is occupied with a single, however complicated, topic. Thus, to put the matter crudely, we begin the day with a getting-up consciousness; this is followed by a breakfast consciousness; this by a newspaper or a correspondence consciousness; this by a daily-work consciousness; this by a luncheon consciousness; and so on. The divisions are real, even if they are not very accurate or precise. We notice, further, that these consciousnesses themselves fall into groups. Sometimes we are stirred and moved by the topic of consciousness: we are ill-humored, angry, anxious, pleased, relieved, aggrieved, hopeful, satisfied and what not. Sometimes we are passive, indifferently taking things as a matter of course. Sometimes we are hard at work, resolute to solve a problem or to overcome a difficulty or to extricate ourselves from an embarrassing position, bending all our energies upon a given end. Sometimes, again, we are unable to concentrate ourselves; we are talkative, reminiscential, fanciful, dreamy, whimsical. A very little introspection of this sort will suggest the distinction of the great mental categories of memory, attention, imagination, emotion, etc. Once more, we notice that the consciousnesses which fall under these categories are complex. Take the emotion of anger. It is not a simple, unanalyzable experience, but is made up of part-processes. There is the idea of the scene or act that has called up the anger; the idea of retaliation; the feeling of injury or of wounded self-esteem; all sorts of memories of one's own or of others' conduct on similar past occasions; and all sorts of «bodily» feelings,— a choking or strangling, perhaps, or a feeling of strength and power, coming with a brace of the body and a clenching of the fist. These part-processes are readily distinguishable; and they take us a step further in the analysis of consciousness, and show us the concrete processes that are termed, technically, perception and idea, feeling and desire, etc. Lastly, we may notice, after a little scrutiny, that these processes in their turn are, literally, concrete: not simple, but made up of simpler elements. My idea of retaliation, for instance, is an idea of something that would take time for its fulfilment, of something that would run its course in stages or phases. And it is more than probable that each one of the stages would, under accurate observation, turn out to be a concretion and not an elementary process.

Now this work of analysis, which we have so far pursued without the aid of any technical method, constitutes the first part of the real problem of psychology. The psychologist is called upon, first of all, to determine the number and nature of the mental elements. Mind, like all other organizations,— like the natural world itself,— is built up from certain irreducible elements; and if we are properly to understand it, we must catalogue and describe its elementary processes. Psychologists are nowadays fairly well agreed that the mental elements are of two kinds or classes: sensations (blue, gold, sour, tone C, the sensations of pressure on the skin, of muscular contraction, of smell, etc.), the ultimate constituents of the intellectual life, and affections (pleasant, unpleasant), the ultimate constituents of the life of feeling and emotion. There is no simple process underlying the volitional life; all acts of will, all resolutions and choices, are made up of sensations and affections in conjunction. On the other hand, mind is not adequately described as a resultant or derivative of the two elements. It is true that every consciousness, in the last resort, is compounded of so many sensations and a certain affection. But we find that the elementary processes of a consciousness may differ, not only in degree or intensity (as strong and weak, loud and faint), but also in clearness or distinctness. So we may speak of a «state» of consciousness, very much as we speak of the state of the roads, or of the weather or of a man's affairs. We speak always in terms of the same material: in terms of the road-bed, of rain and shine, of capital and interest. In the case of consciousness, we speak always in terms of the ultimate elements, sensations and affections. Only, as the road may be firm or muddy, the weather clear or threatening, the financial outlook good or bad, so may the processes in consciousness be clear or obscure, distinct or indistinct, powerful and insistent or ineffective, overshadowed by rival processes. It is worth noting that modern psychology thus finds a use for the phrase «state of consciousness» which is altogether different from its use in the older psychology. When consciousness was identified with the «I,» the phenomena that we now call processes of consciousness were naturally identified with the «states» or «manifestations» of the active principle; and even to-day, in popular writing, the phrase «states of consciousness» is oftentimes employed with the meaning of «conscious processes.» Such confusion of language can only minister to confusion of thought. The processes, the materials of consciousness, are one thing; the state or condition in which the materials are presented is another.

The most important states of consciousness, in the normal life, are those of attention and inattention. In attention, the processes that make up a consciousness run their course at two different levels. The processes attended-to are more clear and distinct, sometimes are stronger and last longer than their fellows; the processes attended-from are depressed, checked, obscured. In inattention, all the processes run at the same low level.

Analysis, then, the first part of the problem of psychology, leaves us with the two elementary processes, sensation and affection, and with the elementary states of attention and inattention. The psychologist is next required to bring the results of his analysis together, to make a synthesis, to formulate laws of the connection of the elements. The synthesis is tested, at every step, by appeal to introspection, that is, to the actual facts of mental experience. If the analysis has been faulty, the reconstruction will be faulty, will not square with the facts; the method thus becomes its own test of truth. Proceeding in this way, psychology is able to rise to laws or uniformities; it states the laws of color mixture, the laws of affective sequence and composition, the limits of the grasp and duration of attention. Proceeding still further along the same road, it states the laws of the association of ideas, or of the expression of the emotions. In time, it becomes quantitative, and gives numerical formulæ for the intensity of a color contrast or the trustworthiness of memory. In doing all this, it is simply following the example of the sciences of nature, organizing and systematizing its material.

If, now, psychology went no farther, it would still have claims to rank as a science. But it would be a merely descriptive, not an explanatory, science. As a matter of fact, it goes on to explan its phenomena, to give the conditions under which they occur or appear. And at this point we come upon one of those theoretical differences of which we spoke above. What are the conditions of a mental process? Some psychologists affirm that, as the mind is always found together with a living body, so it is always conditioned upon physiological processes; a mental formation of concretion is to be explained by reference to the bodily condition that underlies it. Others, again, make appeal to unconscious or subliminal mental processes, which are the condition of our conscious experience, of the supraliminal mind. And yet others would explain mind by mind, deriving mental process from mental process by a principle of mental causality. We cannot decide between these suggestions; limits of space forbid us even to give an adequate account of them. It may be said, however, that the second is the least satisfactory of the three, while controversy is keenly concerned about the other two. The experimental psychologists tend, perhaps, rather toward the first than the last.

The Method of Psychology.— The special method of psychology is experimental introspection. Two questions arise with regard to it: Is introspective observation ever really valid? And is the experimental method adequate to the whole mind, or only to its simpler processes?

It has been objected that introspection can never yield valid results, for the simple reason that it interferes with the course of consciousness. If consciousness is made up of mental processes, then introspection itself is a process or a group of processes. Hence, whenever I set out to observe a given complex, I introduce into consciousness (by the mere fact of observation) another complex, which must clash with the object of my observation. But this is a poor method which interferes with the very thing which it purports to examine and describe! The objection is usually met by the rule that one must wait to observe a mental process until after it has completed its passage; that introspective examination must always be a *post mortem* examination. On this rule, every introspection would involve memory, and be subject to the errors to which memory is subject; though the memory is in play so soon after the event to be remembered that these errors may be considered minimal. In reality, both the objection and its answer seem to beg the question of what introspection is. What the psychologist does, when he introspects, is to experience attentively, to live attentively, the process under investigation, and to make a report about his experience in words. No new process is introduced into consciousness. Whether the words that describe the experience are uttered as the process runs its course, or are pronounced after it is over, will depend upon the circumstances of observation and upon the psychologist's ability and training: no single rule can be laid down in the matter. As thus understood, there can be no question but that introspection is a valid form of scientific observation. And even apart from this theoretical justification, introspection is justified by its results.

The second question, that of the scope of experiment in psychology, has been much discussed, and with very different results. If we face it in the light of history, it seems to answer itself. Psychologists were told, at first, that they could not push the borders of experiment beyond sensation. But they invaded the spheres of affection and attention. They were then told that expermient was adequate only to the simplest states and processes of mind. But they experimented upon perception and idea, upon association and memory and imagination. They were told again that experiment could never attain to the purely intellectual, or indeed to any of the higher aspects of the human mind. But they made experiments upon judgment and reasoning, and upon the æsthetic consciousness. It is true that these latter experiments are few and scattered, and that whole consciousnesses still await experimental investigation. But there seems to be no doubt that, in principle, the entire realm of mind is susceptible to experiment. With a method thus justified, it can only be a matter of time for psychology to establish herself as securely as physics or physiology.

The Various Departments of Psychology. — Many attempts have been made to classify the different departments of psychology in accordance with some logical plan. As no such classification has received general acceptance, we may ourselves abandon the attempt to be logical, and simply pass in brief review the most important branches of psychology that exist at the present time.

We may distinguish, at the outset, an analytical from a genetic psychology. Defining roughly, we may say that analytical psychology takes the human mind as it is, and aims to distribute its elements and laws, while genetic psychology seeks to trace the growth of mind from its first beginnings, and to explain the present in the light of mental history. It is needless to say that the two psychologies overlap at many points. Analysis can seldom be completed, except by help of genetic considerations; and the study of psychogenesis implies, on its side, an analytical knowledge of the developed mind. Genetic psychology is also termed comparative psychology, and has various subdivisions: animal psychology, child psychology, the psychology of adolescence, etc.

We may distinguish, secondly, between qualitative and quantitative standpoints within psychology. Suppose, for example, that I am interested to determine the least difference between two weights that can be perceived by the lifting hand. The numerical result that I obtain is a quantitative result in analytical psychology. If, however, I attempt to trace out the various conscious factors that contribute to my judgment of difference or no-difference,— factors of expectation, of habit, of fatigue, of attention, that may affect the judgment; factors of attentive comparison, of association, of first impression, of effort or ease, that may directly prompt the judgment,— then I am performing a qualitative experiment. The two sorts of result should always go side by side, and should (in a perfect psychology) run exactly parallel,— a numerical statement accompanying the introduction of every qualitative term. Both are indispensable to complete knowledge. Genetic psychology is, at present, almost entirely qualitative, and will probably remain so for a considerable period. It is but the other day that statistical methods were introduced into the study of organic evolution.

We may distinguish, once more, between psychology as a science of mental function and psychology as a science of mental structure. The difference is very much like that which obtains between anatomy and physiology. Structural psychology seeks to discover what consciousness is composed of, when the organism is functioning in a certain way. I remember, or I recognize, or I imagine. What, then, are the constituent processes of the memory consciousness? What is my mind made up of, when I am recognizing? What actually takes place mentally, when I imagine? Many interesting facts have been brought to light by structural psychology. Thus it has been shown that, when we recognize an object, we ordinarily do so, not by way of a comparison of the perceived thing with its memory image, but simply by way of a diffused "feeling of familiarity," consisting essentially of those organic (internal) sensations which enter into the bodily attitude of relief or freedom from tension. Functional psychology seeks, in its turn, to classify and derive the functions of consciousness, the uses to which mind is put in the service of the organism. Thus it may reduce the root-functions of mind to those of cognition and interest, and trace the differentiation of the former into discrimination, integration, comparison, etc., and that of the latter into the manifold modes of conative (will) and emotive consciousness.

All these psychologies are, in one sense of the term, individual psychologies; they discuss the composition or genesis of a single, typical mind. There is, however, a specific, individual or differential psychology, whose problem it is to trace the correlation between the processes or functions characteristic of a certain type of mind, and to compare this with other minds of different types. Thus it is a fact of individual psychology, in this sense, that some minds depend mainly upon visual, other again upon auditory, and still others upon kinæsthetic (motor) images in the processes of memory, imagination and thought. Over against individual psychology, in this meaning of the word, stands national or racial psychology, which attempts to discover the forms of thought and feeling characteristic of the common mind of a people.

This common mind is, indeed, a fertile field for psychological cultivation. The mind of a people is, from one point of view, nothing more than the aggregate of the minds of the individuals composing the people. There are no new processes in the common mind: common mental processes are impossibilities. From another point of view, however, the common mind offers a distinct problem to psychology. The mental productions of men in society differ from the mental productions of the individual. No single man would ever have invented language in order to talk with himself; language is a product of the common mind. One mind may take on a habit; it requires at least two to make a law or a custom. These products of the common mind — mythology, and religious observances, language, law and custom — are treated by social psychology, which approaches them by analytic, comparative and genetic methods, and seeks to explain them in part from the nature of the individual mind, in part from the circumstances in which man, as a social being, has at various epochs of his history been placed.

Lastly, we may contrast normal with abnormal psychology. This deals with such transitory abnormalities as sleep and hypnosis, or with the chronic derangements of insanity. In every case, the key to the abnormal mind is to be found in the status of attention. In dreams, we have a limited and irregular distribution of attention; in hypnosis, an exaggerated passive attention, with its accompanying suggestibility. And we have misdirection, inertia and decay of attention variously exhibited in the various forms of mental disorder.

Here our list of the principal departments of psychology may come to an end.[*] All through, introspection is the special psychological method, and the dictum of introspection is the final appeal. Animals and infants and the insane cannot, of course, be called upon to introspect. Nor, for that matter, can a "common" mind. But we observe the conduct of children and animals, and interpret it in the light of our own adult introspections; we search for parallels to the abnormal in our own normal consciousnesses; and we base our study of social psychology upon the laws of the individual mind.

Mind and Body.— The question of the relation of mind to body is an old one in the history of philosophy; but it is a question that still awaits its answer. Psychology cannot avoid it; and we may, therefore, give here a brief indication of current views.

The two rival theories now most in vogue among systematic psychologists are those of psychophysical parallelism and of interaction. The former declares that mental and bodily processes run side by side, without mutual influence or interference. Every mental process is paralleled by a nervous process. But the nervous processes are links in the unbroken chain of physical causation; and this is complete in itself. Mind is wholly unable to work changes in matter. The latter theory affirms, on the contrary, that mental process influences and is in turn influenced by bodily process: our grief makes us cry, our idea that it is late makes us run to catch a train, as truly as our fit of indigestion makes us gloomy, or a cold in the head makes us stupid.

Common sense is, naturally enough, on the side of interaction. Nevertheless, the theory presents grave difficulties. We must either admit that mind is a special mode of energy, capable of give-and-take with the various forms of energy familiar to us in the natural world; or we must assume that the mind can, without expenditure of energy, deflect the course of physical molecules. Parallelism, while it sins against common sense by making mind causally inefficient, epiphenomenal, has at least the advantage that it leaves the order of the natural universe intact. It has, indeed, further advantages. It has proved to be an admirable working hypothesis for scientific psychology; and it is a purely empirical and non-committal statement of the relationship of mind and body,— a statement that may be reconciled with diverse forms of philosophical belief. It leads, perhaps, most directly to the philosophical doctrine of panpsychism, according to which consciousness is the reality and the concomitant brain-process a phenomenal symbol of this reality. This doctrine serves to reconcile the conflict between parallelism and interactionism, seeing that it guarantees the efficiency of mind while it insists upon the parallel relation of mind and body. It may be noted that Gustav Theodor Fechner (1801–87), the father and founder of experimental psychology, combined an acceptance of psychophysical parallelism, as a working hypothesis for the laboratory, with a belief in panpsychism as the only tenable metaphysics.

The Relation of Psychology to Other Sciences and to Philosophy.— Psychology comes into manifold relation with the natural sciences. As a quantitative science, it requires the aid of mathematics; as an experimental science, it requires the aid of physics. In all its forms, it presupposes a knowledge of the physiology of sense-organs and nervous system: if it seek its explanations in physiology, this knowledge must be accurate and detailed. Insanity can be understood only in the light of pathological histology; comparative psychology rests upon comparative anatomy and comparative physiology.

Nor is the relation less close with the "mental sciences." Social psychology comes into contact with anthropology and ethnology; with political history and sociology; with philology; with the history of art, religion, law,— the history of civilization at large. It is, indeed, hardly too much to claim for psychology the central position in the classification of the sciences: a position that connects it equally with the sciences of nature, on the one hand, and the sciences of the productions of the human mind on the other.

The relation of psychology to philosophy is less easily defined. Until very recently, psychology was not a science at all, but a branch of philosophy. Now that her independence is established, psychology naturally tends to emphasize the breach between herself and the philosophical disciplines. Philosophy, on the other hand, unwilling to recognize the independence of a revolted subject, insists that psychology runs into danger as soon as ever she rejects metaphysical guidance. There is truth in both attitudes. One may be a good psychologist, at the present day, without having opened a philosophical book. Contrariwise, one cannot approach the fundamental questions that lie before and after psychology without plunging, at once, into problems of epistemology and of metaphysics. As with life and matter, so with mind; there is practical work to be done in physics and biology and psychology that may be done, and well done, without philosophical reference. But the practical work springs out of, and leads toward, theoretical issues of the widest kind.

It may be added that the central position of psychology is further warranted by its relation to the special departments of philosophy. Functional psychology is the necessary basis of logic; social psychology is the only straight path to a sound ethics; a psychological analysis of the sentiment of beauty is the prerequisite of æsthetics; the psychology of the religious consciousness is the propædeutic to a philosophy of religion. See APPERCEPTION; BRAIN; BODY AND MIND; DURATION; EMOTION; HYPNOTISM; IDIOCY; INSANITY; LIMINA; PERCEPTION; PSYCHOLOGICAL APPARATUS; PSYCHOPHYSICS; SENSATION; SENSATION, ORGANIC; SENSES; SOUL; SUGGESTION; WEBER'S LAW; WILL.

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[*] "Experimental psychology" is simply psychology approached by the experimental method; it is not a special branch of psychology. "Physiological psychology" is a phrase used sometimes as an equivalent of experimental psychology, sometimes as an inclusive term, covering (besides experimental psychology) a portion of the physiology of the central nervous system.

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PSYCHOLOGY, Animal. See ANIMAL PSYCHOLOGY.

PSYCHOLOGY, Ethnic, a division of psychology under which some modern writers include their efforts at the analysis of the mental differentiations of communities, peoples, races or tribes. The term is not in favor with a great number of writers, who include this field under social psychology, ethnology, etc. Consult Le Bon, G., 'The Psychology of Peoples' (London 1898).

PSYCHOLOGY, Social. See SOCIAL PSYCHOLOGY.

PSYCHOLOGY OF THE ABNORMAL. By the psychology of the abnormal is meant the psychology of individuals who are classed as abnormal, or those individuals who evidence in their conduct or speech or in the character of their ideas or emotions responses that stamp them as being unusual or as differing from the usual, the average, along the lines that make them less efficient in dealing with the various problems of life which they meet and have in some way to adjust to. Considered in this way the psychology of the abnormal is not a different psychology from the psychology of the normal; it is only the application of psychological principles of explanation to the understanding of the various kinds of failure of adjustment which may arise in the career of individuals.

An individual, from this point of view, may be considered as one considers a bit of material that is being tested as to its strength, its breaking point. A bar of iron, for example, may be tested by having a force applied to determine the number of pounds that must be added in order to break it. The breaking point is the function of two factors, the strength of the bar and the force applied. Some bars, the smaller ones, for instance, will break with the application of much less force than others, the larger ones, and theoretically any bar, no matter how strong, can be broken by a force if the force is only great enough. Then again, the exact place where it, the bar, breaks and the way in which it breaks, whether by a clean cut fracture at right angles to the application of the force or in a jagged irregular line depends upon the nature of the material and its uniformity or lack of uniformity of texture at the point of application. So some individuals will fail at comparatively simple problems of adjustment, while others will only fail when the problems are very difficult. And further the way in which an individual fails will depend upon his personality make-up, the kind and character of material with which he meets the difficulties.

The individuals who can only meet the simplest problems of adjustment are the defectives: at the lowest level the idiots and imbeciles, higher up the backward children and still higher the types of so-called psychopathic individuals who present an outward appearance of normality but whose lives disclose a continuous series of avoiding, side-stepping responsibilities and an incapacity for that continuity of effort necessary for success. Stronger individuals only break down under the most difficult of problems, usually only after struggling more or less ineffectually for a long time and then often only as a result of some physical illness which temporarily has reduced their strength and so comparatively increased that of the stressing forces.

Still bearing in mind the analogy to the testing of the strength of material, those individuals who only break as a result of great stress are the better organized and their failure is due rather to the degree of stress than to a faulty make-up — the failure is largely *exogenous* in origin. Those who fail to adjust to relatively simple problems show that the trouble is within, that it is more dependent upon a faulty make-up than upon the character and degree of stress. In these the failure is largely *endogenous* in origin.

Abnormal psychological reactions are thus failures of adjustment; failures of the personality make-up of the individual to adequately meet the stresses and strains. His incapacity to meet these stresses and strains may be due to their very great strength or to his relative weakness and his weakness may be constitutional, that is, natural to him, the result of inherited influences; or acquired as the result, for example, of illness, infectious diseases, injury, more especially to the brain, or methods of life that he cannot escape, such as solitary confinement in prison.

The individual symptoms of the failure are in their general characteristics dependent upon the personality make-up. That is, the disorder of the psyche must manifest itself in terms of the material disordered. Certain details of the symptoms, however, may take their coloring from the surroundings in which the difficulty occurs. This is manifest in the false beliefs — *delusions* —which occur so frequently as symptoms. An individual may compensate himself for his failure by a belief that some baneful influence is exercised over him by others. Now-a-days he not infrequently believes the influence to be brought to bear by means of wireless electricity. Manifestly, before the days of wireless transmission no such belief would have been possible.

The psychological symptoms of individuals who are mentally ill indicate the nature of their difficulties and the means which they are bringing to bear to meet them. They indicate, in other words, the existing status of the problem of adjustment with which they are confronted, the degree and character of the failure.

The most familiar symptom of mental illness is *delirium* which commonly accompanies poisoning, as by alcohol (drunkenness, delirium tremens) or some physical illness particularly when accompanied by infection and high fever. In delirium the principal mental symptom is that of confusion. The patient sees all sorts of things which pass before his vision in kaleidoscopic procession and hears voices, sometimes emanating from the people of his visions, sometimes just coming out of space. These false perceptions — *hallucinations* — are the characteristic phenomena of delirium and to the onlooker seem quite meaningless and incoherent. When the patient gets well, however, it is possible to trace their references and to appreciate that they represent the outcroppings of worries, anxieties and impulses which had before been held in check. Delirium results when illness removes the power of efficient reaction and releases all those tendencies which otherwise had been under control. There is little capacity for adjustment. With recovery from the physical illness the delirium tends to subside. Similarly when we see a picture like this, a *deliriod* type of reaction but not the result of physical illness we feel that the powers of adjustment are pretty well broken, that the constructive forces of the personality are in abeyance.

Delusions are false beliefs which represent a somewhat more definite situation as between the stresses and the personality. Delusions always represent definite attempts at adjustment, but because they are not successful, only compromises. The weak man believes himself strong, the poor man rich, while quite commonly the recognition of weakness within as a cause of failure is avoided by the delusion that malicious influences from without are the cause of the trouble. This is the mechanism of *projection* and is at the basis of delusions of persecution which are so characteristic of that mental disease known as *paranoia* and all sorts of *paranoid* types of reaction in other mental illnesses and also of those unhappy individuals who are always filled with suspicions of those about them.

Hallucinations and delusions may be the passing phenomena of some acute upset or, on the contrary, they may become fixed, stereotyped and definitely organized into a system which is relatively unshakable and remains unchanged over long periods of time. Such a system represents a type of reaction to a defect of personality make-up which is the best that the individual can do and so comes to be a final solution. The delusion is like the scar tissue that fills up a wound. It remains permanently as a disfigurement but it nevertheless represents what has been accomplished by the repair processes.

In still milder forms of mental illness, the *neuroses* and the *psycho-neuroses*, conditions that are on the borderline between the normal and the abnormal and are consistent with a considerable capacity for adaptation and apparent normality, the forms which the symptoms take are somewhat different. They take on the character of what are called *obsessions* or *compulsions*. The patient is the victim of certain ideas, feelings or necessities for action which he recognizes as abnormal or foolish but which he cannot control. Thus in the realm of abnormal ideas he may be forced to think certain disagreeable thoughts, he may be obsessed to think of certain numbers or certain phrases will recur to mind persistently or he may be forced to think how the people he meets would look if they were dead. The obsessive emotions come similarly without apparent reason. He may feel a nameless fear or anxiety or be depressed without apparent cause or he may have definite fears of certain things or situations — the *phobias* — such as claustrophobia, fear of closed spaces, misophobia, fear of contamination, etc. Compulsive acts are equally common. The patient may be forced to touch every tree he passes or forced to step over every crack or start upstairs always with the same foot. In this group are the so-called *manias* such as kleptomania, the necessity for stealing, although there may be no desire for the stolen object, pyromania the necessity for setting fires, etc. All of these tendencies represent instinctive trends which force themselves to expression but which, because they demand for their satisfaction inacceptable forms of conduct seek these devious ways of expression by attaching themselves to what usually appear to be unimportant activities.

All these abnormal forms of expression, delusions, hallucinations, obsessions, compulsions are then efforts at expression of certain instinctive tendencies which are not acceptable to the individual. They represent indulgences that at some past period were normal to the individual, that is, they are relatively infantile. The individual who flies into a rage and curses and kicks the inanimate objects of his environment, breaks furniture and tears up books, is acting like a small child that has been thwarted in some of its desires. All the other abnormal reactions could be explained in a similar way so that we might say that the abnormal as a class are not yet fully grown in some aspect of their personality, they retain infantile traits of character. This is obvious in the idiots and imbeciles but less obvious as we have to deal with better developed personalities. This explanation, however, becomes again obvious in those very dilapidated types of chronic mental illness that degenerate into helplessness, who wet and soil themselves as do infants and have to be fed and otherwise cared for just like children. Mental disease, therefore, shows reactions that reproduce types of response that were at one time normal either in the history of the individual — infancy and childhood — or in the history of the race-primitive man and from this point of view their study has been termed paleopsychology.

There are two ways of reacting to these inherent difficulties— conflicts — of instinctive expression either by turning back within onesself and reanimating infantile ways of reacting — the method of *introversion* — or by running away from the difficulty, so to speak, into reality and by developing a great activity and interest in everything about and so attempting to escape a reckoning with onesself — the method of *extroversion.* The first is, in general, the more serious type and in it we find the malign types of the psychosis such as dementia precox: the second is less serious and here we find the more benign types such as the manic-depressive psychosis. A chronic delusional psychosis such as paranoia represents a more or less permanent compromise which is not as disintegrating as the first nor as recoverable as the second.

All these methods of reacting are found equally among the relatively normal; the only differences are differences of more or less. In mental disease we find the mechanisms of normal mental life writ large because disproportionately emphasized in some direction. The symptoms of mental disease can thus be understood as the outward evidences of attempts at adjustment, made difficult by some psychological conflict and the language of the symptom, so to speak, can be translated when it is understood as expressing reactions of escape, defense or compromise in the face of the problem presented. The study of these exaggerated forms of reaction found in the mentally ill has gone a long way to help explain the psychology of the normal because the failures represent an experiment of nature, so to speak, which throws certain of the aspects of the personality into relief. A complicated mechanism comes to be understood when it gets out of order and finally by taking it apart.

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PSYCHOLOGY OF ADVERTISING AND SALESMANSHIP. See Advertising, Psychology of.

PSYCHOLOGY IN ITS APPLICATIONS TO MEDICINE AND PSYCHIATRY. See Medicine and Psychiatry, Psychology of.

PSYCHOLOGY OF EDUCATION. See Education, Psychology of.

PSYCHOLOGY OF RELIGION. See Religion, Psychology of.

PSYCHOPHYSICS. By some this science is regarded as synonymous with physiological psychology; by others, as dealing particularly with the phenomena which bring out the relation of sensations to physical stimuli. In this character it deals with the study of Fechner's and Weber's laws as a separate department of psychological science. Psychophysics deals particularly with the measurements of intensity of sensations, and endeavors to establish general laws regarding the phenomena. See Duration; Limina; Reaction Time; Weber's Law.

PSYCHOZOIC, a term used by a few geologists to indicate the time since man came into the world. Some prefer to give it the rank of an era, but it is usually called the Recent Epoch of the Quaternary period, and the name Psychozoic is but little used.

PSYCHROMETER, an instrument for measuring the tension of aqueous vapor in the atmosphere. It is also known as the wet-bulb hygrometer. See Hygrometer.

PTAH, ptä, or **PHTHA,** Egyptian god of the most ancient type, described in inscriptions as «creator of the earth, father of the gods and all the beings of this earth, father of beginnings.» He was compared by the Greeks to Hephæstus, being, like him, patron of metalworkers and sculptors. Representing the beginning of all things he was shown as an undeveloped child or dwarf (Ptah-Patack), or as a mummy. He had a magnificent temple at Memphis. See Egyptian Religion and Sociology.

PTARMIGAN, tär'mĭ-gan, a grouse of the genus *Lagopus,* which differs from the ordinary grouse in having the legs feathered to the claws, giving somewhat the appearance of a hare's foot (whence the generic name). The truncated tail has 14 or 16 feathers, most of the species become white in winter, and the nasal groove is densely clothed with feathers. There are six or eight species described, inhabiting the northern and snow-covered regions of both hemispheres, being one of the few genera characteristic of the arctic fauna; they are as much at home in snow as are the web-footed birds in water, and their plumed feet enables them to run over its surface without sinking in. They live in families during most of the year, and are monogamous; the females incubate, but the males assist in rearing and feeding the young. The males have a loud harsh or sometimes clear cry, and the females cackle like a hen. They flv swiftly without a whirring noise, and run well. They feed upon berries, buds, mosses and lichens and insects. Their pursuit affords an exciting sport; they are very shy, but when started are easily shot on account of their regular flight. The summer plumage is varied with brown, black and gray, most of the wing remaining white; in the males the mottling is finer and the colors brighter. There are three well-ascertained species in America, besides several subspecies and races. The white ptarmigan or willow grouse (*L. lagopus*) is about 16 inches long and 24½ inches in alar extent; the bill is black, very stout and convex, and broad at the tip; the general plumage in summer is rufous or orange chestnut on the head and neck; feathers of back black, closely barred with yellowish brown and chestnut; most of wings and lower parts white; tail brownish black; in winter white, with black tail; no black stripe through the eye. It occurs commonly in the northern parts of America, and in rare instances in the northern United States (Maine and Minnesota). It is found in open rocky grounds and among dwarf willows and birches. In winter they scratch in the snow down to the mosses and lichens on which they feed, collecting often in considerable flocks. In winter the flesh is dry, but is tender and with an agreeable aromatic flavor in summer. They breed in

Labrador about the beginning of June, placing the nest under the creeping branches of low firs; the eggs are from six to 14, of a fawn color or rufous ground with irregular spots of reddish brown; only one brood is raised in a season. The rock ptarmigan (*L. rupestris*) is 14½ inches long; the bill is slender, rather compressed at the tip; in summer the feathers of the back are black banded with yellowish brown and tipped with white; in winter white, with the tail black (the four middle feathers white), and the male with a black bar from the bill through the eyes. It occurs in arctic America, from Alaska to Labrador and the Gulf of Saint Lawrence. The white-tailed ptarmigan (*L. leucurus*) is found on the alpine summits of the Rocky and Cascade Mountains from New Mexico to the Artic regions. This species is entirely white in winter; and in summer the tail, wings and lower parts of the breast are white, the remainder of the plumage being a fine mixture of gray, brown and black. A fourth species (*L. welchi*) is attributed to Newfoundland. Of the Old World species the red grouse (*L. scoticus*) is peculiar to the British Islands and a famous game bird. Unlike the other members of the genus it does not become white in winter. A typical ptarmigan (*L. alpinus*) is found in northern Europe, especially in Norway. Our own willow grouse, or a closely related species, also occurs. Consul Baird, Brewer and Ridgway, ‹North American Land Birds› (Boston 1874). See Grouse.

PTERANODON. See Pterodactyls.

PTERASPIS, a fossil fish. See Ostracodermi.

PTERICHTHYS, tĕ-rĭk'thĭs, a genus of extinct fishes belonging to the subclass *Ostracophori* and considered to be remotely related to the modern lampreys. *Bothriolepis* is a related genus from the upper Devonian formations of America, as well as the Old World. None of the species exceed a few inches in length. The affinities of these strange forms are little understood. See Ostracodermi.

PTERIDOSPERMÆ, tĕr'ĭd-ō-spėr'mē, or **PTERIDOSPERMEÆ,** in paleobotany, a *class,* co-ordinate with *Gymnospermæ* and *Angiospermæ,* of fossil Paleozoic fern-like plants, including all such which on the evidence available appear to have been reproduced by means of seeds. Potonie called this class *Cycadofilices.* And some paleobotanists even regard the group as a *phylum,* or primary division, and not as a *class;* and to this phylum they then apply the name «Pteridospermaphyta»; but the idea of the group's being a *class* is gaining favor. A single plant of the group is a «Pteridosperm.» The cases in which the evidence available appears to be decisive are but few; and to these have been applied the names which follow: (1) *Lyginodendron oldhamium;* (2) *Neuropteris boterophylla;* (3) *Pecopteris Pluckeneti;* (4) *Aneimites fertilis;* and (5) *Aneimites tenuifolius.*

In the first named pteridosperm, Lyginodendron oldhamium, the structure both of the vegetative and reproductive organs is known; and the evidence from comparison and association is sufficiently strong. So identification is certain and easy. And in the other cases there is direct proof of continuity between seed and plant; but only the external characters are known. In a great number of forms amounting to a majority of the Paleozoic plants of fern-like habit, the evidence — such as it is — is in favor of their having possessed *seeds.* They are pre-eminently plants resembling ferns in habit and in many anatomical characters but bearing *seeds* of the *Cycadean* type. Seeds and microsporangia,— or pollen sacs of the anthers,— are low on the fronds, and only slightly modified as compared with the vegetative leaves in Pteridospermæ. Pteridospermæ, of which only a few examples have so far been considered by paleobotanists, evidently constituted a group of vast extent in Paleozoic times. In a large majority of the fern-like fossils of that period the evidence is in favor of *reproduction by seeds* rather than by the *cryptogamic methods* of *true ferns.* The whole class of Pteridospermæ though clearly allied to the typical Gymnospermæ may be kept distinct for the present on account of the relatively primitive characters shown in the anatomy and morphology of the former. During recent years a number of Carboniferous and Permian plants have been very thoroughly investigated in the light of modern anatomical knowledge, and as a result it has become clear that in those times a large series of plants existed intermediate between the modern Gymnospermæ,— especially the Cycads,— and the true ferns.

The first definite evidence of the mode of reproduction of Lyginodendron oldhamium was due to the studies of F. W. Oliver, who in 1903 identified the seed Lagenostoma Lomaxii by means of the glands on its capsule, which agree exactly with those on the associated leaves and stems of the plant. No similar glands are known on any other Palæozoic plant. Lagenostoma Lomaxii is a small, barrel-shaped seed, 5.5 by 4.25 mm. when mature, enclosed in a husk or capsule, which completely envelops it when young but ultimately opens. The male organs of Lyginodendron oldhamium were discovered by Kiddon, a year or two after the seeds were identified. They are of the type known as Crossatheca, formerly regarded as a Marratteaceous fructification. This is the *first* case in which the pollen-bearing organs of a Pteridosperm have been identified. It will be noticed that while the seeds of Lyginodendron oldhamium were of an advanced Cycadean type, the microsporangiate organs were more like those of a fern, the reproductive organs thus showing the same combination of characters which appears in the vegetative structure. It must here be mentioned that the family Calamopityeal, allied anatomically to Lyginodendreæ, is of the Devonian and Lower Carboniferous age.

Bibliography.— Potonie, ‹Lehrbuch der Pflanzen-paläontologie› (Berlin 1899); Renault, ‹Cours de botanique fossile› (Vols. I–IV, Paris 1881–85); Scott, D. H., ‹Studies in Fossil Botany› (2d ed., London 1908–09); Seward, A. C., ‹Links with the Past in the Plant-World› (Cambridge 1911); Stopes, M. C., ‹Ancient Plants› (1910).

PTERIODOPHYTES. See Ferns and Fern Allies; Paleobotany.

PTERODACTYLS, tĕr'ō-dăk'tĭlz, an order of extinct flying reptiles technically known as Pterosauria. They lived exclusively during the

Mesozoic period, from the beginning of the Jurassic to near the close of the Cretaceous. Their fossil remains have been found in Europe and North America, but are best known from the chalk deposits of western Kansas, where many hundred specimens have been collected. Of known reptiles they are nearest allied to the dinosaurs (q.v.); they are only distantly related to birds. They are especially characterized by their very hollow bones and the extraordinary elongation of the fourth (according to some authors, the fifth) finger, which supported a thin bat-like membrane that extended to the sides of the body and the legs. Not only were the bones very hollow, more so than in any living birds, but they were composed of very dense osseous tissue and were pneumatic, that is, had openings, usually near the ends, for the ingress and egress of air, as in birds. The nature and extent of the wing membrane, or patagium, are known from impressions in the rocks, but the covering of the body elsewhere is still in doubt. That the body is not clothed with feathers is certain, but it may have had, like that of most reptiles, horny scales.

The neck was more or less elongated and very flexible; the legs were relatively feeble and of but little use in locomotion upon land; the breastbone, which is poorly developed in other reptiles and wholly absent in early reptiles, was of great size, covering the whole under side of the thorax. Unlike birds, however, it had no real keel but only a stout projection in front for the attachment of muscles. The pelvic or hip bones were well developed for the support of the hind legs, which were of material use in flight. The fifth finger was absent; the first three fingers were short and useful only for clinging to rocks and branches.

In all the early kinds, those from the Jurassic, the skull, of moderate length, was provided with long and sharp teeth. The tail was long and flexible and had at its extremity a diamond-shaped expansion for use in controlling flight. The bones of the skeleton were less hollow and the wing was proportionally less elongated. The first bone of the wing-finger, that is, its metacarpal, was relatively short, never longer than the forearm, and the first three fingers were articulated directly with the wrist. There were five separate toes and the feet were of some use upon land. None was of large size, not exceeding five or six feet in expanse. The best known form is *Rhamphorhynchus* (Fig. 1), and the group or suborder is known as the *Pterodermata.*

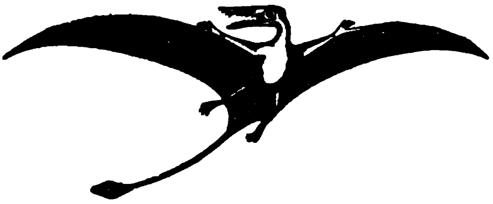

FIG. 1.—The Rudder-tailed Pterosaur, Rhamphorynchus phyllurus Marsh. From the lithographic shales of Solenhofen (Jurassic). One-seventh the natural size.

The later and much more specialized group, beginning near the close of the Jurassic, known as the *Pterodactyloidea,* had the skull more elongated, the wing-finger longer, with its metacarpal longer than the forearm, the first three fingers of the hand loosely attached in the flesh, the tail vestigial, the pelvis larger and firmer and the feet with only four toes. The earliest of these, of which *Pterodactylus* is the best known example, were small, some with a body not larger than that of a sparrow, and they had teeth in the jaws. The later ones, however, those from the Upper Cretaceous, of which so many are found in America, reached a size of more than 20 feet from tip to tip of wings. The skull was very long and slender, in some with an enormously developed crest upon the back of the head, and the jaws were without teeth. The neck was longer and more flexible, in many with additional articulations, giving greater strength; the bones of the shoulder were united into a firmly ossified ring, which, unlike all other known animals, articulated directly with the spinal column; the wrist was firmer; the wing-finger still more elongated; the small bone of the legs had disappeared, as in birds; and the first bone of the ankle, the astragalus, had become indistinguishably united with the leg bone, as in birds. The most noted member of this group is *Pteranodon.*

In their maximum and final development the pterodactyls attained the highest volant powers of all creatures, whether of the past or present, being quite incapable of locomotion except in the air. *Pteranodon,* with a wing expanse of 22 or more feet, had a body smaller than that of a turkey. *Nyctosaurus,* an allied genus from Kansas, with a body only six inches long and five or six inches across the shoulders, measured eight feet from tip to tip of expanded fingers, and probably did not weigh more than five pounds when alive. They doubtless spent most of their time in the air, resting suspended from cliffs by their small clawed fingers, much like the way of bats, except that their fingers, instead of their toes, are used for suspension. The presence of bony plates in the sclerotic membranes of the eyes indicates either nocturnal or soaring habits. (Cf. Fig. 2).

In flight, unlike birds and bats, their «wings» served more as gliding surfaces, and could have been used only for upward and downward motion. Flight was controlled by the legs, which were extended backward and connected by membrane, serving the purpose of the feathered tail in birds. The rudder-tailed *Rhamphorhynchus* (Fig. 1) was a veritable monoplane.

Their food habits are only imperfectly known. Because so many of their remains are found in ocean deposits, it is believed that they fed largely upon fishes, and this assumption is strengthened by the discovery, in several instances, of the remains of their stomach contents containing comminuted fish-bones. But it is probable that they also lived in part upon other flying creatures, insects and small birds, which must have been swallowed whole. Their brain was better developed than in other reptiles, and because of this and of the highly-developed, pneumatic skeleton, it has been thought by some that they were warm blooded; they have even been placed in a separate class of back-boned animals. They were, however, true reptiles, even though warm-blooded, which may have been possible.

Remains of young pterodactyls have never been found. Like most reptiles they were probably oviparous, since otherwise, among the many hundreds of known specimens, embryonic young would probably have been found. The bones of the pelvis, unlike those of birds, were closely connected, and only eggs of small size could have passed through it, not much larger than hens' eggs, even in the largest kinds. Such small young would have been practically helpless, which, together with the greater intelligence of the adult animals, as indicated by their large brains, renders it probable that the young were cared for by the parents until able to care for themselves. These facts suggest limited breeding grounds, and extensive seasonal migration. (Note Fig. 3).

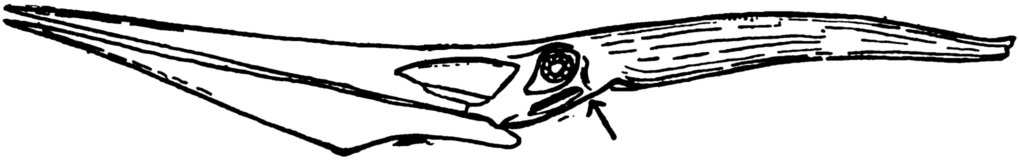

FIG. 2.— Outline of the skull of *Pteranodon longiceps* (from the Kansas chalk), showing the great steering crest. The crest is fully two-fifths the length of the skull, which measures nearly four feet from tip of sharp bill to end of crest.

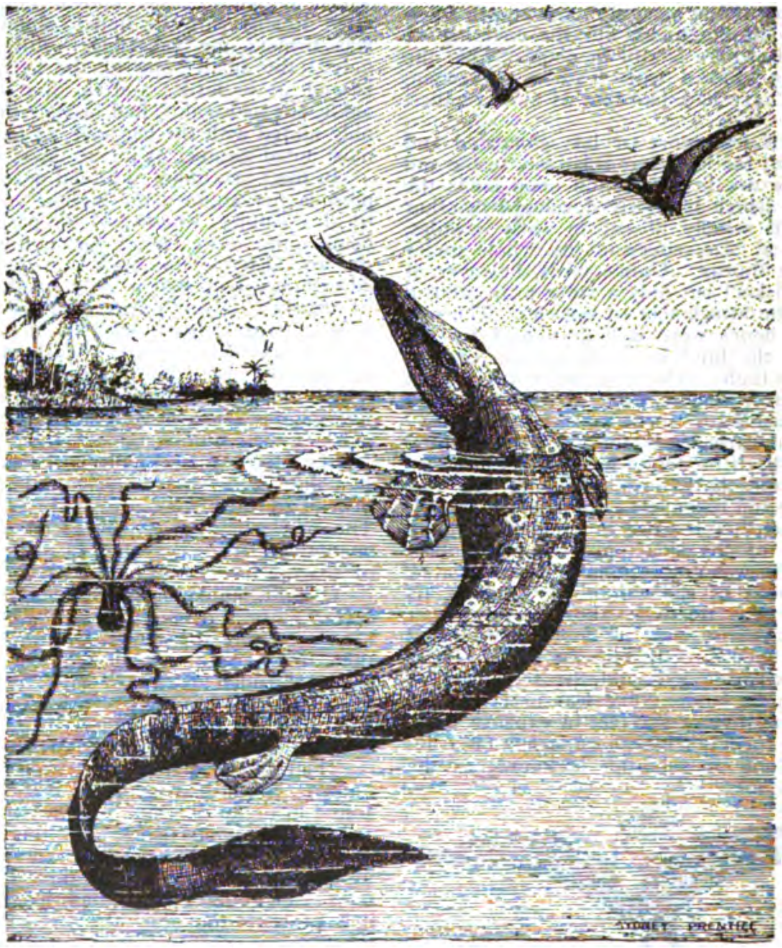

FIG. 3. — *Crested Pterodactyls* as they appeared in life, hovering over the palm-lined shores of the Kansas inland sea of the chalk period. (The details are scientifically accurate. A mosasaur and crinoid or "stone-lily" in the foreview).

About a dozen genera are defined, of which *Rhamphorhynchus*, *Dimorphodon*, *Pterodactylus*, *Pteranodon* and *Nyctosaurus* are best known. In North America, with the exception of some fragmentary remains from the uppermost Jurassic, *Pteranodon* and *Nyctosaurus* are the only, though abundantly represented genera.

Bibliography.— Cuvier first named this group. Consult the «Ossemens Fossile,» (1809 and 1824). Also consult Buckland's Bridgewater Treatises, 1837. Later works are H. G. Seeley's 'Ornithosauria and Dragons of the Air' (1870 and 1901). The discovery and description of the American forms is found in the scientific writings of O. C. Marsh, S. W. Williston and G. F. Eaton. Consult especially Eaton, 'Osteology of Pteranodon,' Memoirs of the Connecticut Academy of Arts and Sciences for July 1910, where many illustrations of the Pteranodon crests are given.

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PTEROPOD OOZE. See PTEROPODA.

PTEROPODA, a group of mollusks, formerly regarded as a distinct class, but now known to be only a suborder of the episthobranch gastropods, especially modified for a pelagic life. Like the other opisthobranchs, they are simple in structure, the heart being posterior in position and the nervous system without a trust. They are hermaphroditic. The name pteropod refers to the ring-like development of lateral processes (parapodia) of the foot, which serve as fins by means of which the animals swim. The head and usually the tentacles and eyes are lacking. Some of the species are naked, while others secrete delicate shells, which are in some cases spiral (*Limacinidæ*), or straight slender cones (*Carolinidæ*), or more or less pyramidal (*Hyaleidæ*). All of the species are small, many being almost microscopic in size. In certain parts of the ocean these animals are so abundant that their dead shells, accumulating on the bottom, have given the name «pteropod ooze» to the deposits. In the northern seas one species (*Clione papilionacea*) occurs in enormous numbers, forming a large element in the «brit» on which the right whales feed. Fossil pteropods are well known from all rocks from the Lower Cambrian to the present. Consult authorities cited under MOLLUSCA. See OOZE.

PTEROSAURIA, a subclass of Mesozoic reptiles, prominently characterized by the power of flight; the pterodactyls. Anatomically, they have fixed quadrate bones, and the anterior limbs formed into wings, with enormously elongated ulnar finger carrying a patagium. The group consists of an order (*Pterosauri*), divided into two suborders: *Pterodactyli* and *Pteranodontes.* See PTERODACTYLS.

PTERYGIUM, a fan-shaped patch of mucous membrane on the ocular conjunctiva, its base being usually at the inner angle of the eye (the canthus), its apex at the margin of the cornea or overlapping it. It may appear on the temporal side of the eye; sometimes two of the patches occur in the same eye and cover the whole cornea as with a thick veil, preventing vision. Pterygium occurs in middle and advanced life, and may be either stationary or progressive. In the progressive form the patch is fleshy and the vessels are pronounced; in the non-progressive form it is pale and flat. The ordinary (regular) pterygium is due to irritation of the conjunctiva by dust and minute bodies. It may become inflamed and lead to ulceration of the conjunctiva and cornea and to impaired vision. Irregular pterygium is usually the result of burns or ulcerations. Paronychia is sometimes spoken of as pterygium digiti; pinguicula, a fan-shaped yellowish patch on either side of the cornea in old age, due to irritation from dust, etc., and leading to colloid inflammation, is sometimes called pterygium landaceum or pterygium pingue. Pterygium unguis is a condition in which the epidermis coats the nail with a thin transparent layer. For treatment of peterygium, removal by excision, strangulation, cauterization or curettement may be employed. See EYE and consult works referred to under that article; also 'Reference Handbook of the Medical Sciences' (New York 1916).

PTERYLOGRAPHY, the description of the arrangement and habit of growth of feathers (*pterylosis*) on the body of a bird. A bird's plumage does not grow evenly from the whole surface of the skin, but in certain tracts (pterylæ), the form, extent and disposition of which differs in the various orders, families and genera; so that the pterylosis is a character of importance in classification. The fact that the nearest approach to a uniform clothing of feathers occurs now in the ratite birds, penguins and the like, which are lowest in organization and of most ancient origin among birds, indicates that pterylosis is a comparatively modern acquisition, and its more striking manifestations occur among birds otherwise referable to a high rank in classification. The principal feather-tracts are similarly disposed in all the groups and consist of a tract embracing the head; a tract along the spine; a line along each side of the neck, down each side of the breast and along the side of the abdomen curving inward to meet at the vent; a line lengthwise across the shoulders; two patches upon each leg; and the regions of growth of the wing and tail feathers. The disposition of the powder-down tracts is also a part of pterylography. This matter was first expounded by the German naturalist, Nitzsch, author of 'Pterylographie' (Halle 1847), whose work was translated and extended in a volume of the Ray Society of London for 1867. Consult Newton, 'Dictionary of Birds' (1893–96).

PTERYLOSIS. See PTERYLOGRAPHY.

PTOLEMAIC SYSTEM, *in astronomy,* the system by which Claudius Ptolemy tried to explain celestial motions. For 14 centuries this was the universally accepted and authoritative system of astronomy, only being completely overthrown upon the development of the Copernican system by Kepler toward the middle of the 17th century. The very long time during which the system of Ptolemy was received may perhaps be more clearly realized from the statement that though it was first proposed so early as the 2d century, A.D., in the early days of our American universities it was still taught in connection with that of Copernicus. This was doubtless because, so far as was evident from the rough, naked eye, observations of the sun, moon and planets, it seemed to account for all of their complicated apparent motions in a wholly satisfactory manner. According to this system the earth is the fixed centre of the universe; a vast sphere, the «primum mobile,» carries all the clestial bodies, and rotates once a day; the sun and moon travel in eccentric circles round the earth, and this accounts for the annual motion of the sun, and the monthly motion of the moon; each planet moves in a circular path, termed its epicycle about a point, and this point travels in an eccentric circle round the sun; all motions in each order of circle being described uniformly, this explained the looped paths, the progressions, stations and retrogradations of the planets. But every new astronomical observation required a new contrivance on this system, and at length the necessary cyclic and epicyclic combinations became excessively cumbrous. The discovery of the elliptical form of the orbits, in the 17th century, and especially the development by Newton of the principles of mechanics, which wholly govern all the motions of the planets, quickly made it evident that the reality of the Ptolemaic system was a manifest impossibility.

PTOLEMY, tŏl'ĕ-mĭ (Ptolemaios), the name of a line of Græco-Egyptian kings, who ruled from the death of Alexander the Great till the Roman occupation of Egypt 323–30 B.C. The name Ptolemy, though the common, was not the exclusive name of the kings of this dynasty, and they are better distinguished by the surname Lagidæ, from Ptolemæus Lagus, the founder of the dynasty, also surnamed Soter. Consult Budge, ‘A History of Egypt’ (New York 1902); Mahaffy, ‘The Empire of the Ptolemies’ (London 1895); id., ‘A History of Egypt under the Ptolemaic Dynasty’ (New York 1899); Meyer, ‘Das Heerwesen der Ptolemäer und Romer in Ægypten’ (Leipzig 1900); Starck, ‘Die Dynastic der Ptolemäer’ (Berlin 1897).

PTOLEMY I (called Soter, “the Saviour”): b. Macedonia; d. 283 B.C. According to Lucian he was born about 367 B.C., but on the supposition of his being a son of Philip it must have been some years later. In 330 B.C. he was admitted into the body-guard, and from this time appears in important transactions. During the Indian campaigns he was regularly employed in the most important commands, and distinguished himself alike for valor and capacity as a general. He continued on terms of intimate friendship with Alexander, and accompanied him in his last campaign 324 B.C. On the death of Alexander he attached himself to the party of Perdiccas, and secured for himself the government of Egypt. He then proceeded to strengthen himself in his government, and concluded a secret league with Antipater against Perdiccas. In the arrangements made after the death of Perdiccas Ptolemy retained Egypt; and subsequently strengthened himself by marrying Eurydice, daughter of Antipater. On the death of Antipater (319 B.C.) Ptolemy united with Cassander and Antigonus against Eumenes, and on the defeat of Eumenes by Antigonus joined Cassander and Lysimachus against Antigonus, who invaded Syria, 315 B.C., overran Phœnicia, and laid siege to Tyre, which he took in 314 B.C. Cyprus revolted in 313, and Ptolemy proceeded thither in person, and reduced the whole island. In 312 B.C. he invaded Palestine. In 311 a general peace was effected, but it was not of long duration and was broken by Ptolemy in 310 B.C. In 308 he invaded Greece, but made little progress, and Antigonus now resolved to wrest Cyprus from Ptolemy (307 B.C.). The Egyptians were totally defeated at Salamis, and Cyprus fell into the hands of the victor, who assumed the title of king. In 305 B.C. Ptolemy assisted the Rhodians against Demetrius, and from the Rhodians on this occasion acquired his surname of Soter. In 302 a league was formed against Antigonus, but alarmed by a false report that Antigonous had won the battle of Ipsus he retired to Egypt. The defeat and death of Antigonus in this battle raised Seleucus to a position of great power, and a dispute ensued between him and Ptolemy 295 B.C. Ptolemy recovered Cyprus, which became a permanent dependency of Egypt. Ptolemy had two sons by Eurydice, but determined to bestow the crown on Ptolemy Philadelphus, a younger son by his favorite wife Bernice. He announced his own retirement, and caused him to be proclaimed as his successor 285 B.C. Ptolemy is regarded as the most prudent of the successors of Alexander. His internal administration of Egypt was enlightened and successful. He raised Alexandria to the highest rank in commercial prosperity, and founded in that city a colony of Jews, to whom the special place taken by Alexandria in subsequent times in philosophy and literature, as well as in politics, was in great measure due. He was also an eminent patron of literature, science and art, and founded the library and museum of Alexandria. He himself wrote a narrative of the wars of Alexander, used as authority by Arrian. For bibliography see Ptolemy.

PTOLEMY II (Philadelphus): b. Cos, 309 B.C.; d. 247. He was raised to the throne during the lifetime of his father Ptolemy I. He concluded a treaty with Rome after the defeat of Pyrrhus, and continued faithful to his allies during the Carthaginian War. There was a chronic but uneventful war carried on during his reign with Syria. Toward the close of his reign it was terminated by the marriage of Ptolemy's daughter Bernice to Antiochus III. Either by the treaty or in the course of the war Ptolemy acquired Cœle-Syria and Phœnicia. He was also, in general, on hostile terms with Macedonia. But the chief care of Ptolemy was directed to the internal administration of his kingdom and the encouragement of commerce. He founded Arsinoë (on the site of Suez) to protect the navigation of the Red Sea and Berenice on the Red Sea Coast, and from the latter place formed a road to Coptos on the Nile, by which the commerce of India and Arabia continued for ages to pass to Alexandria. The chief glory of Philadelphus was his munificence as a patron of science and literature. He raised the institutions founded by his father to the highest degree of splendor and spared no pains to fill the library of Alexandria with all the treasures of ancient literature. Among architectural works of merit erected during his reign were the lighthouse on the island of Pharos, the Alexandrian Museum, and the royal burying-place. He founded numerous cities and colonies not only in Egypt, but in Syria and Cilicia. He is supposed to have been the patron of Manetho in his Greek rendering of Egyptian history, and there is a tradition that it was at his instance that the Seventy made their translation of the Old Testament. During his reign the dominion of Egypt extended into Ethiopia, Arabia and Libya and embraced the provinces of Phœnicia and Cœle-Syria, besides extensive tracts in Asia Minor and the islands of the Mediterranean.

PTOLEMY III (surnamed Euergetes). son of Ptolemy II; d. 222 B.C. He succeeded to the throne at the death of his father 247 B.C. He was early engaged in an important war with Antiochus III of Syria, who had put away his wife Laodice to marry Berenice, daughter of Ptolemy II. On the death of Philadelphus he put away Berenice and restored Laodice. The resentment of Laodice, however, was not appeased, and she sacrificed to her revenge her husband, her rival and their infant son. To avenge his sister Ptolemy invaded Syria and advanced to the confines of India. Recalled to Egypt by intelligence of seditions there he brought with him the statues of Egyptian gods carried off by Cambyses, which he restored to their respective temples, and thus earned the title of Euergetes (benefactor) from his subjects. The fleets of Ptolemy had at the same time subdued the coasts of Asia Minor and carried his arms to the Hellespont and to the coast of Thrace. Ptolemy took some part in the affairs of Greece generally, as was the policy of Egypt, against the rulers of Macedonia; maintained friendly relations with Rome, but declined the assistance of the Romans in his war with Syria. He continued the patronage of literature and added largely to the library of Alexandria. Like his predecessors he was the patron of scholars and his court was the resort of the most distinguished men of his day. In his reign the Græco-Egyptian kingdom attained its highest prosperity at home, and its widest dominion abroad.

PTOLEMY IV (surnamed Philopater), son and successor of Ptolemy III; d. 205 B.C. He put to death his mother Berenice, his brother Magas and his uncle Lysimachur and abandoned the cares of state to his minister Sosibius, his adviser in these and other crimes. Roused from his lethargy by the loss of his Syrian possessions, wrested from him by Antiochus the Great, Ptolemy completely defeated Antiochus at Raphia, 217 B.C. By this victory he recovered Cœle-Syria, but speedily made peace and returned to his pleasures. He continued in general the policy of his ancestors, patronized literature and dedicated a temple to Homer as a divinity. During the Carthaginian War he supplied the Romans with corn.

PTOLEMY V (surnamed Epiphanes), son and successor of Ptolemy IV: b. 210; d. 181 B.C. He was but five years old at his father's death and Philip of Macedonia and Antiochus III (the Great) of Syria combined to dispossess him and divide his dominions. Instead of relying on the internal resources of the kingdom to repel this danger, the guardians of the young king took the fatal step of placing him under the protection of Rome. The charge was gladly accepted by that crafty state and Philip and Antiochus were commanded to restore their conquests. Antiochus, to avoid embroiling himself with the Romans agreed, 199 B.C., to give Ptolemy his daughter Cleopatra in marriage, with the Syrian provinces as her dower. In 196 B.C. Epiphanes was crowned, being declared of legal age. In 195 B.C. the priesthood of Egypt erected in Ptolemy's honor the famous Rosetta Stone (q.v.), commemorating the remission of the sacerdotal dues. The marriage to Cleopatra took place 193 B.C., nevertheless when war later broke out between Antiochus and Rome, Egypt espoused the cause of the latter. Ptolemy was cut off by poison while he was preparing to recover Cœle-Syria from Seleucus, the successor of Antiochus. Nearly all the foreign possessions of Egypt were permanently lost during the unfortunate minority of this reign.

PTOLEMY VI (surnamed Philometor), son of Ptolemy V, was also a child at the death of his father. His mother Cleopatra, who assumed the regency, maintained peace and preserved internal tranquillity by an able administration; but the ministers who succeeded after her death (173 B.C.) provoked a war with Antiochus Epiphanes and were totally defeated near Pelusium. Antiochus advanced to Memphis and took Ptolemy prisoner (170 B.C.). Upon this the brother of Ptolemy caused himself to be proclaimed king at Alexandria, under the title of Ptolemy Euergetes II. Antiochus then re-established Philometor as king of Memphis, and returned to Syria. The brothers ruled jointly till 168 B.C. Dissensions now broke out between them, and Philometor, expelled from Alexandria, went to Rome 164 B.C. By the intervention of the Romans he was replaced, but agreed to erect Cyrene into a separate kingdom for Euergetes, who afterward persuaded the Romans to grant him Cyprus also. In 145 B.C. Philometor was mortally wounded in battle near Antioch, when arrayed against the Syrian Alexander Balas. In the latter part of his reign Philometor showed an energy of which he did not at first appear capable, and he is generally praised for the mildness and moderation of his character. During his reign a great migration of Jews, caused by factions in their own country, took place from Palestine into Egypt.

PTOLEMY VII (surnamed Euergetes II, and also Physcon), son of Ptolemy V, was king of Cyrene at the death of his brother Ptolemy VI, d. 117 B.C. Cleopatra caused her infant son to be crowned; but Ptolemy invaded Egypt, and by the intervention of the Romans it was agreed that he should marry Cleopatra and be recognized as king. Immediately after the marriage he put his nephew to death. Shortly after he married his niece, Cleopatra. The relations between the mother and daughter were of continuous hostility. For many years Ptolemy's reign was one of tyranny and bloodshed, and compelled at length to flee from the indignation of his subjects led in revolution by the elder Cleopatra, he escaped to Cyprus 130 B.C.. He was restored to authority 127 B.C., and thereafter bent his energies to restoring the ravages of former years. He died in peaceable possession of the throne of Egypt. He was not only a patron of literature, but the author of a considerable work on natural history.

PTOLEMY VIII (surnamed Soter II, or Lathyrus); d. 81 B.C. He was the son of Ptolemy VII by the latter's niece Cleopatra. Already married to his sister Cleopatra at the time of his accession his mother compelled him to divorce her and marry his younger sister Selene, and for 10 years she continued to sway the government, although she and her son were frequently opposed in policy. She accused him of conspiring against her life, and he was compelled to flee. She recalled her younger son, Alexander I, from Cyprus, whereupon Soter II took control of his brother's kingdom and for 18 years he held Cyprus as an independent kingdom. After the death of Cleopatra he was recalled to Egypt in the year 88 B.C. and governed till his death. The latter years of his reign were marked by the rebellion which resulted in the destruction of Thebes. He was succeeded by his daughter Cleopatra-Berenice.

PTOLEMY IX, or **ALEXANDER I,** youngest son of Ptolemy VII; d. Cyprus 88 B.C. On the expulsion of Ptolemy VIII he shared with his mother Cleopatra the throne of Egypt, although he appears to have had little power. The violence of his mother at length caused him to flee; but persuaded to return and suspecting her of designs against his life, he caused her to be assassinated 101 B.C. After reigning until about the year 89 B.C. he was expelled by an insurrection of his own people and soldiers, who recalled his brother. Ptolemy IX was killed in battle the following year.

PTOLEMY X, or **PTOLEMY ALEXANDER II,** son of Ptolemy IX; d. 80 B.C. He was nominated king of Egypt on the death of Ptolemy VIII; but the Egyptians having already placed Cleopatra-Berenice, the daughter of that king, on the throne, it was arranged that he should marry her and admit her to a joint sovereignty. Nineteen days after the marriage he caused her to be assassinated, upon which the Alexandrians rose in insurrection, dragged him to a gymnasium and put him to death. With him the legitimate male line of the Ptolemies became extinct.

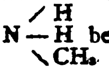
PTOLEMY XI (AULETES, surnamed PHILOPATOR PHILADELPHUS NEOS DIONYSUS), an illegitimate son of Ptolemy VIII; d. 51 B.C. He succeeded Ptolemy X, notwithstanding his claim to succession was doubtful. In vice and debauchery he appears to have rivaled the worst of his predecessors. The oppressive taxes he imposed caused his expulsion by the Alexandrians in 58 B.C. In 55 B.C., A. Gabinius, proconsul of Syria, by the influence of Pompey and a bribe of 10,000 talents, was induced to restore him. The Egyptians, who had placed Berenice, the daughter of Auletes on the throne, were defeated and Ptolemy put Berenice to death. During the rest of his reign Egypt was occupied by the Romans.

PTOLEMY XII (AULETES), son of Ptolemy XI; d. 48 or 47 B.C. He reigned jointly with his sister Cleopatra till 48 B.C., when Cleopatra was expelled and raising an army in Syria invaded Egypt. It was at this time that Pompey landed in Egypt after his defeat and was assassinated by the ministers of Ptolemy. On the arrival of Cæsar, Cleopatra by her charms acquired an ascendency over him, which made it manifest that he would decide her dispute with Ptolemy in her favor. Ptolemy put himself at the head of the insurgents, was defeated by Cæsar and drowned in attempting to make his escape.

PTOLEMY XIII (AULETES), youngest son of Ptolemy XI; d. 43 B.C. He was declared king by Cæsar in conjunction with Cleopatra in 47 B.C. He was married to his sister but was later put to death by her to make room for her son Cæsarion (b. 47 B.C.), claimed by Cleopatra to be the son of Julius Cæsar. From this time until Cleopatra's death in the year 30 B.C., the child was nominally coregent under the name of Ptolemy XIV. After the battle of Actium, Cæsarion was betrayed into the hands of Octavius who caused his murder and thereafter Egypt became a Roman province.

PTOLEMY (CLAUDIUS PTOLEMÆUS), Alexandrian astronomer, geographer and mathematician: flourished about the middle of the 2d century after Christ, being probably born at Ptolemais in the Thebaid. The geocentric system of astronomy which he taught was accepted in Europe until after the time of Dante, whose poem takes this theory as its frame-work. In producing his principal work, 'Μεγάλησύνταξιςτῆς Αστρονομίας' Ptolemy relied very much on the labors of Hipparchus; but his planetary theory is his own, as well as his theory of the moon's evection (q.v.). The Ptolemaic system of astronomy was only exploded by the arguments of Copernicus (q.v.). The mediæval writers speak of the astronomical treatise of Ptolemy under its Arabian name of the Almagest. It consists of 13 books, the principal of which, the first, reveals the trigonometrical theory of the Greeks; contains a method for calculating chords and demonstrates the basal doctrine of trigonometry, that the rectangle of the diagonals of an inscribed quadrilateral equals the sum of the rectangles of the opposite sides. There is also to be found there sufficient spherical geometry and trigonometry to enable a calculation to be made of the sun's declination to each degree of longitude. These principles are applied in detail through the remaining 12 books. The predecessor of Ptolemy in the field of geography was Marinus Tyrius, whose works he utilized and corrected. His geographical treatise is entitled *Γεωγραφικὴ Ὑφήγησις*, and contains little more than a list of places with their longitude and latitude. He also corrects the geographical methods of Eratosthenes, Hipparchus and Marinus and he actually executed 26 maps in illustration of his theories. There are other spurious works of Ptolemy and many of his writings have been lost. The best and most recent edition of his works is that edited by Heiberg, T. L., 'Claudii Ptolemaei Opera Quae Extant Omnia' (in 'Bibliotheca Scriptorum Graecorum et Romanorum Teubneriana,' 3 vols., Leipzig 1898–1907). Consult Ball, R. S., 'Great Astronomers' (London 1895); Cooley, W. D., 'Claudius Ptolemy and the Nile' (London 1854); Cronin, H. S., 'Ptolemy's Map of Asia Minor; Method of Construction' (in *Geographical Journal*, Vol. XXV, p. 429, London 1905); Dinse, P., 'Die Handschriftlichen Ptolemänskarten, etc.' (in *Zentralblatt für Bibliothekwesen*, Vol. XXX, p. 379, Leipzig 1913); Eames, W., 'A List of Editions of Ptolemy's Geography, 1475–1730' (New York 1886); Gerini, G. E., 'Researches on Ptolemy's Geography of Eastern Asia' (London 1909); Haskins, C. H., and Lockwood, D. P., 'The Sicilian Translators of the 12th Century and the First Latin Version of Ptolemy's Almagest' (in *Harvard Studies in Classical Philology*, Vol. XXI, p. 75, Cambridge 1910); McCrindle, J. W., 'Ancient India Described by Ptolemy' (Bombay 1885); Peters, C. H. F., and Knobel, E. B., ed., 'Ptolemy's Catalogue of Stars' (in *Carnegie Institution of Washington, Publications*, No. 86, Washington, D. C., 1915); Roscher, A., 'Ptolemæus und die Handelstrassen in Afrika' (Gotha 1867); Rylando, T. G., 'The Geography of Ptolemy Elucidated' (Dublin 1893); Schütte, G., 'Ptolemy's Atlas; a Study of the Sources' (in *Scottish Geographical Magazine*, Vols. XXX–XXXI, Edinburgh 1914–15); Tudeer, L. O. T., 'On the Origin of the Maps Attached to Ptolemy's Geography' (in *Journal of Hellenic Studies*, Vol. XXXVII, pt. I, p. 62, London 1917); Winsor, J., 'A Bibliography of Ptolemy's Geography' (in *Harvard University Library, Bibliographical Contributions*, No. 18, Cambridge 1884).

PTOMAINES, a series of organic nitrogenous bodies, closely resembling the vegetable alkaloids in many of their chemical properties. They are present in many animal products, and are formed either by the chemical breaking down of complex nitrogenous molecules or by bacterial agencies capable of inducing similar decompositions. Most of the ptomaines are ammonia compounds. By the older chemists all of this group of so-called animal alkaloids were termed ptomaines, but later studies have given a series of groups of these bodies. Thus ptomaines, leucomaines and toxins are at present recognized; the former being the results of abnormal catabolic changes, due to chemical or bacterial agencies; the leucomaines being usually normal catabolic compounds of this group. The toxins are ptomaines, products usually of bacterial decomposition or ferment activity of some type or other, and which are poisonous. Many of the ptomaines are inert; others, the toxins are poisonous, some highly so. Ptomaine-poisoning resulting from eating altered sausage meat, mussels, tinned meats, etc., is due to some form of toxin. Chemically the ptomaines contain carbon, hydrogen and nitrogen. They belong mostly to the amines or substituted ammonia compounds, monomethyl amine, $N \begin{smallmatrix} \diagup H \\ - H \\ \diagdown CH_3 \end{smallmatrix}$ being one of the simplest of these bodies. It is present in many decomposing foods, and even as mercurialine in a living plant. Dimethylamine, $(CH_3)_2NH$ and trimethylamine, $(CH_3)_3N$, are similar ptomaines of this simpler group. Amines of higher alcohols are also common forms, ethylamine, butylamine and others being examples. Putrescine and cadaverine are more complex ptomaines which have been isolated from putrescent meat. They are both diamines. Neuridin, $C_5H_{14}N_2$, was one of the first of this class isolated by Brieger, the practical founder of the study. Choline, neurine, betaine and muscarine are four oxygenated ptomaines of closely related chemical structure that are peculiarly convertible one into another by simple chemical processes. Choline is non-poisonous, but neurine and muscarine are highly toxic. They are found in decomposing meat. Muscarine, from the poisonous fly-mushroom, is thought to be identical or very closely similar to the choline, neurine, muscarine compound. Mytilotoxin is the specific poison of the mussel. Typhotoxin and tetanotoxin are ptomaines supposed to be the active poisons produced by the typhoid fever and lockjaw bacteria. Tyrotoxicon is a toxic ptomaine found in cheese and in ice cream. At least 200 ptomaines have been described. (See TOXINS and ANTITOXINS). For a full consideration of the many lines of thought on this subject, consult Vaughan, V. C., 'Ptomaines and Leucomaines and Cellular Toxins' (with Dr. Novy); 'Protein Split Products' (with Vaughan, V. C., Jr., and Vaughan, J. W., 1913).



PTOSIS, tō'sĭs, a falling or drooping of the upper eyelid owing to paralysis of the muscle that lifts it. It is somtimes congenital and it may be produced by various disorders of the brain.

PTYALIN. See SALIVATION.

PTYALISM. See SALIVATION.

PU-LU, poo'loo. See FERNS AND FERN ALLIES; FIBRE.

PUBERTY, the period in both male and female marked by functional development of the generative system. This period, when capacity for reproduction begins, is indicated in both sexes by certain characteristic signs. In the male puberty is generally reached, in temperate climates, between the ages of 15 and 18, and although it is commonly believed to be reached somewhat earlier in warm regions, climatic conditions appear to affect the male less than the female. Before the attainment of this period the physical powers have been appropriated to the nutrition of the body. This is in accordance with a well-known law of physiology, whereby the processes of nutrition and reproduction are mutually antithetic; the reproductive energies are opposed to the nutritive, and act as an important drain upon the physical and nutritive powers. Therefore the generative instincts are limited or restrained until nutrition and growth have been duly advanced.

In the male the occurrence of puberty is marked by a varied and general change in the physical constitution. The body attains, within a comparatively short period, a large relative increase in size. The form acquires greater fulness and stamina. The larynx particularly enlarges; the voice deepens; there is a growth of hair upon the face, the pubes, etc.; and the entire sexual system receives an unwonted stimulus, the testes secreting the seminal fluid characteristic of full sexual vigor. The male thus reaches sexual maturity. In ordinary cases his virile powers decrease after the age of 50 or 60, when the energies seem to be withdrawn from the reproductive function in the interest of nutrition.

In the female the state of puberty usually begins, in temperate climates, between the 14th and 16th years. At this period the female form acquires a characteristic fulness and roundness. The breasts enlarge, depositions of fat taking place in the mammæ and on the pubes, and over the body generally. The internal organs of generation also enlarge, and their functional perfection in woman is marked by the most unequivocal of the signs of puberty, the appearance of menstruation (q.v.). The production of ova, ready for fertilization, is the most essential and significant sign of the full attainment at once of puberty and of the true female generative functions. (See OVARY). Puberty in both man and woman may be retarded or advanced by individual and inherited peculiarities of constitution and by modifying circumstances and habits of life.

PUBLIC ARCHITECTURE. See UNITED STATES ARCHITECTURE.

PUBLIC BILLS. See BILLS, COURSE OF; ACTS OF CONGRESS.

PUBLIC DEBTS. See DEBTS, PUBLIC.

PUBLIC DOMAIN. See BOUNTIES; PUBLIC LANDS.

PUBLIC FINANCE. 1. Definition and Scope of Public Finance.— Governmental organization is necessary in any society which has passed beyond the lowest stage of social development, and in modern industrial states the functions and needs of the government are large and important. Public finance treats of the raising and application of the resources of the state. It analyzes the needs of the state and the means by which these needs may best be met, that is, it treats of public expenditure and public revenues. It also describes the methods by which these are determined upon and raised, which leads to a discussion of financial legislation and budgetary practice. And finally the subject of public credit, by which the orderly income of the state may be anticipated, is included by most writers as falling within the scope of public finances. This gives a fourfold division of the subject.

2. Public Expenditures.— It is practically impossible to lay down any principles governing public expenditures, since before we can do this a prior question has to be answered, namely, what are the proper functions of the state. The answers to this stretch all the way from the extreme individualism of Herbert Spencer, which would limit the duties of the state to the protection of life and property and the enforcement of contracts to the collectivism of modern Socialists, who would enlarge the activities of the state to such an extent that they would absorb all private enterprise. We may, however, treat the question of public expenditure as a practical problem in each specific case, to be determined on its merits without reference to any a priori theory.

Upon one point there is no difference of opinion: the tendency of public expenditures has shown a steady and universal tendency to increase. This has been true under centralized administration, as in France, or under decentralized governments, as in the German states; in large countries like Brazil or in small ones like Belgium; in democratic countries like Switzerland or despotic ones like Russia; in old countries like Greece or new ones like the United States. Part of the seeming increase, to be sure, may be accounted for by the growth of the population, the growth of money payments in lieu of payments in services or kind, the general advance in wealth and the decline in the value of money. But after making all these allowances there still remains a real increase to be accounted for, especially since the beginning of the 19th century.

The direction of the growth of public expenditures will become clearer if we distinguish three classes, namely, those for protection or defense, those involved in carrying on public works and those for the social welfare of the citizens. The first includes not only military expenditures, but also those for police, the courts and the preservation of domestic tranquillity. Some years ago Herbert Spencer laid down the dictum that as society advanced it would expend less for militarism and more for amelioration, but the former part of this statement at least seems not to have been borne out by the facts. Responsible for this is the growing cost of modern armament. War is incredibly expensive, the total money cost of the World War being estimated at about $186,000,000,000. Peace to-day costs the great modern powers more than the most expensive war of antiquity, and the greater the progress in invention the greater is the expense involved in replacing obsolete equipment with new. Even in a country as free from war as the United States has been in the last 50 years, over two-thirds of the Federal expenditures to-day are directly or indirectly attributable to war and preparation for war. Police and court and similar expenses probably show a tendency to decrease, and it is possible that the future may also see a decline in the expenditures for war, but no such tendency can now be predicted.

There is a decided tendency for the second group of functions to increase. The number and variety of services undertaken by the state is daily increasing, and there is constant pressure from the citizens of all modern states that the government shall expand its functions still further. The post office, national railways, telegraph and telephone systems, municipal water, light and street car systems, are a few of the more important lines along which the state has entered the industrial field, while most governments own lands, forests and mines which they administer. As to whether these enterprises shall cause a corresponding increase in net expenditures or whether they will pay for themselves is a matter of public policy and administration. If managed on business principles the growth of this group will have no effect in increasing the burden upon the taxpayer.

Expenditures for social amelioration and for the development of the well-being of the mass of citizens fall in the third group. These include such items as education, recreation, the care of the dependent and defective classes, and the control and regulation of private industry for the purpose of eliminating unfair and undesirable practices. That these have grown rapidly in the past needs hardly to be stated, and there is every reason to believe that they will increase even more rapidly in the future. From one standpoint they may be regarded as an investment which the modern state makes in its citizens, from which it reaps large returns in the form of greater efficiency, knowledge, contentment, decrease of suffering and improvement in the general standards of living.

The economic effects of public expenditures are far-reaching; if wisely directed they may greatly benefit a people while an unwise outlay may work positive harm. But there is probably no more widespread economic fallacy than that public expenditure, no matter to what purpose directed, is a desirable thing in itself, since it "puts money in circulation." Adam Smith, however, as early as 1775, contended that whether it was beneficial or not depended upon the purpose for which it was spent, and this is the correct view, though sadly overlooked in our pork-barrel and similar wasteful government expenditures in the United States. As to what is regarded as beneficial will again depend upon the particular point of view; war is considered so by some writers. In general it may be said in conclusion that no general rule can be laid down to govern public expenditures.

Much will depend upon the stage of political and social development of a people. But that state may be considered to make the wisest expenditures which returns to its citizens relatively the greatest amount of benefit therefor, irrespective of whether these expenditures be large or small.

3. Public Revenues.— The revenues of the state have been variously classified by different writers, but it is possible to subsume all important sources under two heads, namely, (1) contractual or commercial revenues and (2) taxes or compulsory revenues. According to this classification, fees, special assessments and fines should be included in the second group, while such minor or unusual sources of revenue as gifts or indemnities would be included in the first. For all practical purposes such a broad classification serves as well as the more detailed ones of some writers.

Contractual revenues are derived in general from two main sources, public domains and public industries. Of these the former has been the more important in the United States. There are in general three policies which governments have adopted respecting the public domain. One is for the government to cultivate its own domain. This was the general practice in the mediæval period when the revenues of the ruler were not sharply distinguished from those of the public treasury, and is still followed in many European countries which are influenced by feudal custom. Owing to the intensive nature of agriculture, which calls for close personal attention, this method has not yielded large revenues. In the case of forests, however, this policy may be heartily approved. A second possibility is for the government to retain the title but lease its domain for cultivation. Such a policy would involve serious political dangers in the United States, owing to the pressure to make unduly favorable leases for partisan or personal reasons, and may be dismissed as unworkable. In some of the European countries, however, and notably in India, such a policy seems to work well and is highly endorsed by writers on public finance, especially in the case of mineral deposits. A third method, and this is the one which has been followed in the United States, is for the government to dispose of its public domain by sale or gift. If it is settled by an industrious and intelligent agricultural population the government will probably be able to secure larger revenues from taxation of the increased wealth and land values than from the receipts from direct farming by the state or from rentals from tenants. Solely from the standpoint of public finance, therefore, the policy of the United States government may be approved.

Public industries vary greatly from country to country, as they have varied in number and extent from time to time. At one extreme stands Prussia, owning and operating its railroads, telegraphs and telephones, and in large part managing its mines and forests, to say nothing of its porcelain factories and other government plants. At the other stands probably the United States, which until the war confined itself practically to the administration of the post office. Municipalities differ among themselves no less in regard to their public industries, though here the movement for government enterprises is much stronger than in the case of the central governments. The industries selected for government management have usually been socially desirable but unremunerative, as education; of general interest to all the people, as the post office or waterworks; monopolistic in their nature, as telegraphs or street railways; and fairly simple in administration. The revenues from public industries will, of course, differ greatly from country to country according to the policy of administration.

Taxation remains the principal source of revenues for all modern governments, and one that is growing rather than lessening in importance. A tax may be defined, in John Fiske's alliterative description, as a "portion of private property taken for public purposes." It must always be for a public purpose and it involves the power of legal coercion on the part of the sovereign. Because of this characteristic it is highly essential that a tax system be just and equitable. Probably no passage in the literature of finance is more celebrated than that in which Adam Smith stated his well-known canons of taxation, which may be summarized as follows:

"1. The subjects of every state ought to contribute toward the support of the government, as nearly as possible in proportion to their respective abilities; that is, in proportion to the revenue which they respectively enjoy under the protection of the state.

"2. The tax which each individual ought to pay ought to be certain and not arbitrary.

"3. Every tax ought to be levied at the time, or in the manner in which it is most likely to be convenient for the contributor to pay it.

"4. Every tax ought to be so contrived as both to take out and to keep out of the pockets of the people as little as possible over and above what it brings into the public treasury of the state."

In addition to these requirements of justice, certainty, convenience and economy, a satisfactory tax system should also be productive of adequate revenues, and elastic or responsive to the needs of the government.

Some writers, as for instance the Physiocrats of the 18th century and the single taxers of to-day, argue that a simple system of taxation is preferable to a multiple system, and both of these schools have urged the substitution of a single tax on land or on land values for all existing taxes. It may be urged, however, that it is possible to realize the various ideals just enumerated, especially of adequacy and elasticity, only by a multiple or plural system of taxation. Moreover, only by the employment of various kinds of taxes is it possible for a government to achieve other ends by means of the taxing machinery, as protection, regulation of the liquor traffic, etc. All modern governments use a plural system of taxation, in some cases leaving but a few sources of revenue untapped.

The canon of taxation upon which most emphasis has always been laid by writers on public finance is that of justice. The first question that suggests itself in this connection concerns the relative duty of citizens to pay taxes for the support of the state. How shall the tax burden be apportioned among the taxpayers? . Two main answers have been given to this problem: the benefit and the ability theories of taxation. According to the benefit theory taxes should be apportioned among the citizens according to the value of the services of the government to them — a sort of pay-as-you-use plan. It is evident that an attempt to carry out such a theory practically would result in imposing excessive taxes upon those least able to bear them; the defectives in our state institutions would bear the heaviest burdens. It may be observed, however, that every taxpayer should receive very real benefits from the government which he helps to support, and indeed unless taxation yielded such benefits there would be no justification for it. This, however, is a very different thing from saying that the tax burden should be apportioned in accordance with the benefits which one receives from the government. The more generally accepted theory is the so-called ability theory, according to which each citizen is expected to pay for the support of the state in proportion to his ability as compared with the ability of others. It is the application of Christian ethics to public finance. This is stated in the first canon enumerated above by Adam Smith. "In the observation or neglect of this maxim," he went on to observe, "consists what is called the equality or inequality of taxation." His successors have carried on a lively debate as to what constitutes equality, and, particularly, whether a proportional or progressive rate of taxation corresponds most nearly with the demands of justice. To a consideration of this disputed topic we may, therefore, next turn.

By a proportional tax is meant one that is levied at a constant rate irrespective of the amount of property or income from which it is paid. For instance, a proportional income tax of 2 per cent would exact always the same proportion of the income no matter how large this might be: $20 if the income is $1,000, $200 if the income is $10,000 and $20,000 if the income is $1,000,000. On the other hand in the case of a progressive tax the rate increases as the amount of property or income to be taxed grows greater. Thus in the illustration given above the rate might be 2 per cent on incomes of $1,000 (tax would be $20), 5 per cent on incomes of $10,000 (tax would be $500 instead of $200), and 10 per cent on incomes of $1,000,000 (tax would be $100,000 instead of $20,000). Under progressive taxation a relatively bigger slice of the large incomes in taken than in the case of the smaller incomes. The point at issue in determining the question as to whether proportional or progressive taxation best accords with the principle of justice or equity in the distribution of taxation is whether a man's ability to pay is measured by the amount of property or income he enjoys, or whether his ability increases at a rate more rapid than the growth of his property or income.

The modern tendency is to affirm the latter proposition and to make more general use of the progressive principal. In support of this view a few of the leading arguments may be briefly summarized.

Probably the most popular argument in favor of progression is that it tends to break up large fortunes and to equalize the distribution of wealth. This is doubtless the motive which has led to the approval of inheritance taxes in this country, but in few cases has the application of the progressive principle been drastic enough really to bring about a redistribution of wealth. A second argument is the so-called equality of sacrifice idea: if the rich man is to make a sacrifice proportionate with that of the poor man he will have to give up a relatively larger per cent of his income, because as fortunes grow larger the utility of each dollar grows less. According to this view the burden of the tax is measured by what is left after payment rather than by the payment itself. Another reason has been suggested by Prof. E. R. A. Seligman, namely, that a man's ability to acquire wealth increases progressively — "money makes money" — and hence it is only fair to apply the progressive principle of taxation to rich men. Finally Prof. H. C. Adams urges that there will be a social gain if the very rich older men be discouraged from further accumulation, and by withdrawing from active industry both give the younger men a chance and also devote their talents to philanthropy, social betterment, etc. Against the progressive principle is usually urged the familiar argument that it would discourage industry and saving, and hence mean an economic loss.

In the discussion thus far it has been assumed that when the legislator imposed a tax he knew what its effects would be. Such, however, is not the case. Taxes are generally shifted by the person who makes the first payment to the public treasury by being incorporated in the price of the article taxed. The final resting place of the tax is called its incidence. Two rather simple theories of shifting and incidence have been held, the one, the diffusion theory, holding that wherever a tax is originally imposed it gradually diffuses itself throughout society; hence no tax is so good as an old tax. Another theory, which may be called the concentration theory, argues that the whole burden of taxation, no matter where originally placed, tends ultimately to be shifted upon some particular class or form of wealth; this was the idea underlying the *impot unique* of the Physiocrats. The actual shifting of taxes is, however, much more complicated than either of these theories admits. See article on TAXATION.

The actual tax system of any country is the result of a complex of historical, constitutional and political causes, and that of the United States is no exception. The Federal government has relied for the most part upon indirect taxes — customs and excise duties — though since the amendment of the Constitution in 1913 it has been able also to make use of an income tax, which has already grown heavier as the needs of the Federal government increased. Three-quarters of the State revenues are derived from the general property tax, though the unsatisfactory and inequitable administration of this tax has lead a number of the more progressive States to supplement or supplant this by corporation and inheritance taxes. The great expansion of municipal functions has forced the cities to overhaul their tax systems and to impose heavier burdens upon municipal utilities in addition to real estate.

4. Public Credit.—To say that a state makes use of public credit is equivalent to saying that a government borrows money. Public credit is a branch of general credit and like that depends upon trust or confidence. But the fact that a sovereign state is the debtor in the case of public borrowing differentiates a government bond from other securities. In the first place a state cannot be compelled to pay its debts; but in spite of this fact government bonds are eagerly sought after. This is because the modern state is compelled to maintain its credit untarnished as it is almost certain to need to borrow again. On the other hand, the state has eternal life and hence can make perpetual debts; it has sovereign power to raise by means of taxation the funds for payment of interest and repayment of principal.

In 1820 it was estimated that the civilized governments of the world were resting under a burden of indebtedness amounting to $7,750,000,000. By 1910 this had grown to $40,000,000,000, and since the beginning of the European War in August 1914 these debts have practically quintupled. The growth of great public debts has been almost wholly a phenomenon of the 19th century, and has attended the development of a money market and improved credit facilities, better means of communication and transportation and of modern constitutionalism. The cause of the national debts has been almost exclusively war and preparation for war; State and local debts are usually due to improvements and investments, though sometimes improvidence has occasioned them. In general there are three objects for which a government may properly borrow money. These are to cover a casual deficit, to meet a fiscal emergency and to provide funds for industrial investment.

Temporary but unforeseen deficits may properly be met by the issue of short-term obligations in anticipation of the next tax levy. It may be impossible or undesirable to disturb existing tax rates, and, unless there is a surplus on hand, it is preferable to borrow than to permit a floating indebtedness to be created. Such loans, however, are for short periods and for relatively small amounts.

Much more important is the second group, that designed to care for serious emergencies such as war. In such a case the government cannot wait for the slow increase in revenues from increased taxation; it must have the money at once. The only alternative method of guarding against such a contingency is the so-called "war-chest policy" of Prussia, according to which that kingdom amassed a quantity of precious metals amounting to $60,000,000 and securities for use in case of war. How inadequate such a resource is becomes evident when it is noted that this sum was spent in the first three or four months of the Great War. Only by the use of public credit, perhaps to the breaking point, is it possible for modern nations to meet the cost of war.

The third occasion for public borrowing arises when a government wishes to undertake a scheme of public investment, such as the building or purchase of a railway, a waterworks system, an electric-light plant, etc. If the business is a commercial one it will itself provide the means of repayment, and it is, therefore, unnecessary as well as undesirable to saddle it upon the taxpayers. Moreover, from an engineering point of view, it is desirable to have the whole amount of capital necessary for the enterprise on hand at the start, so that no delays may occur. Debts for this purpose should not, if the business is well conducted, impose any additional burden upon the taxpayers.

There is no magic in government borrowing; it means simply a postponement of the unpleasant necessity of paying one's debts to the next generation. One of the first and most obvious effects of public borrowing is an increase in the tax rate, for the interest must be paid even if the principal is not. If the sums borrowed by the government have been large this lessens the amount of capital available for private industry and consequently raises the rate of interest. Various social and political effects may also be noted, such as the creation of a district bond-owning class, as in France, or the lessened control of our legislatures over the disposal of public funds when existing debts absorb large amounts of revenue.

The technique of public borrowing will be discussed in another place. (See article DEBTS, PUBLIC). It is sufficient to point out at this time that in selling bonds the Minister of Finance must in general appeal to the same motives as the ordinary seller of commercial paper, except that in times of emergency like war the patriotism of the people may lead them to accept somewhat worse terms than they ordinarily would. In fact loans are classified by numerous writers into the three classes of forced loans (such as the issue of irredeemable paper money), patriotic, and voluntary loans, but the last two can really be considered together, as they are both contractual rather than forced.

It frequently happens that when the emergency which forced the government to borrow possibly at very high rates is past, the rate of interest falls. Then, if the government has the right of repayment of the principal, it can avail itself of this opportunity to sell new bonds at a lower rate of interest and to pay off the holders of the old bonds with the proceeds. This is called conversion or refunding. By this process, without any extinction of the principal, the burden of the interest charge on a given amount of debt was steadily reduced for the nations of Europe during the 19th century.

But while conversion may reduce the interest charge it leaves the principal untouched, and states, like individuals, are faced at last with the unpleasant problem of debt payment. As yet it must be said that this problem has not been squarely faced by modern governments. Except for the United States and to a lesser degree Great Britain, almost none of the civilized nations has attempted to pay off its national debt. And yet a sound financial policy requires that this be done as rapidly as is consistent with the economic development of a country.

5. Financial Legislation and Budgetary Practice.— Modern governments carry on their financial operations under well-defined constitutional checks and budgetary practices. Certain general rules of financial procedure are laid down within which legislatures may vote taxes and legalize appropriations or incur debt. The study of these rules forms a fourth and last part of the subject of public finance.

The rise of constitutional arrangements in respect to financial matters undoubtedly originated in England, and it is said that the English system has served as a model for the other European countries. While this is only partly true the English budgetary practice will serve as a convenient point of departure for our study of the United States.

By the word budget is meant a comprehensive report and balance sheet of the past and estimated receipts and expenditures of the government for the next fiscal year. Such a statement forms the basis of legislative action on revenue and appropriation in practically every civilized country except the United States. In England, for instance, the budget for the fiscal year is prepared by the Chancellor of the Exchequer as a member of the Cabinet upon the basis of reports made to him by the heads of departments. This contains a statement of the revenues and expenditures for the past year, together with an estimate of the revenues and the proposed expenditures for the coming year. The government then defends the proposed budget against criticism, modifying it where necessary, but resigning from power and responsibility if the opposition overturns their plans.

Contrast with this highly centralized and responsible method the decentralized and irresponsible practice of the Federal government of the United States. A report is made to Congress to be sure by the Secretary of the Treasury, based upon data submitted by the various department heads, but until recently there was no certainty that the report was trustworthy, and even now Congress is but little influenced by the estimates of the executive department. According to our theory of separation of governmental functions there is no connection between the executive and legislative departments and Congress prefers political independence to financial orderliness. The result is that tax laws and appropriations are determined by political rather than fiscal considerations.

Another striking point of difference between the English and American systems lies in the fact that in the English budget both revenue and expenditures are determined by the same body, while in the United States the taxing and spending powers are allotted to two different sets of committees. Under the English system there is thus possible a well-balanced budget in which the Ministry of Finance, responsible for adjusting outgo to income, is able to avoid either surplus or deficit. At the same time the device of a variable rate for the income tax makes possible an exceedingly accurate equilibrium.

In the House of Representatives in the United States there are some eight different committees which bring in 14 different appropriation bills, of which six are prepared by the Committee on Appropriations. As each of these committees is under the temptation to swell its bill asking for appropriations in order to magnify its own importance, there is constant pressure to extravagance. And when it is remembered that still a different committee, that on Ways and Means, has charge of revenue bills, it is not difficult to see that a well-balanced and harmonious budget is all but impossible under such a system. Not only is there no careful correlation between revenue and appropriations as a whole, but the relation between different categories of appropriations is haphazard and unscientific as they are under the control of different sets of men.

The remedy for these evils is of course the adoption of a budget system for our Federal government. President Taft in 1912 requested Congress to provide for a budgetary form of statement of the annual report of the Secretary of the Treasury, and to follow such procedure in their financial legislation, but without avail. Probably nothing will be done in this direction until the force of public opinion compels Congress to adopt business methods and forms.

The State legislatures shadow forth, rather dimly, the same financial procedure that is found in Congress. It is practically impossible to speak of a scientific budget in any of the States. More progress has been made, on the other hand, in our municipal government, where under the highly centralized administration of the commission or city manager plans of government a budget becomes possible. In the majority of our cities, however, but little more progress toward this fiscal ideal can be recorded than in the case of our State legislatures. They are still in a chaotic state of transition.

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PUBLIC HEALTH, or the health of the people, i.e., of groups or communities of human beings, is to-day a great and growing subject which may be regarded either as a science — and is then nearly or quite synonymous with public hygiene — or as a state or condition of the physical well-being of human groups or societies. As a science, it has of late years, and especially since the great pathological discoveries of the last quarter of the 19th century, taken on new forms and extraordinary importance. As a state or condition, it has also recently attracted much attention in the improvements shown in almost all civilized countries. As a science, it is beginning to be recognized in schools and universities by the establishment of new courses, special teachers and even special training schools — notably at Harvard University and the Massachusetts Institute of Technology, at Yale and at the Johns Hopkins University — an early step in this direction having been taken at the University of Pennsylvania. As a condition, worthy of and demanding world-wide attention, it has led to the establishment of a Federal Bureau in the Treasury Department of the United States government (formerly the United States Marine Hospital Service, later the United States Marine Hospital and Public Health Service and now the United States Public Health Service, having at its head a surgeon-general with several assistant surgeons-general, with a large and important hygienic laboratory (in Washington) and a strong staff of medical men, sanitary chemists, sanitary biologists and sanitary engineers. Private and voluntary associations in great numbers, such as the International Health Board of the Rockefeller Foundation, the American Public Health Association, the American Association for the Study and Prevention of Tuberculosis, the American Society for the Prevention of Infant Mortality, and many others far too numerous to mention, have also been formed and are generally actively at work to promote and improve the public health. The latest step of great magnitude and promise in this direction is the diversion of some of the vast machinery and effort of the American Red Cross remaining after the World War into channels of public health education and sanitary and hygienic betterment. It is plain that the problems of individual or personal health or hygiene are sufficiently complex and uncertain, both of determination and amelioration, but if, instead of dealing with the individual, we deal with groups or masses of individuals in the form of communities, such as families, villages, towns, cities, States and nations, all the difficulties (and these are by no means few) connected with individual hygiene become enormously multiplied and complicated. It is easy to see that when the problems of the individual under varying conditions dealing with a variable environment are multiplied and complicated by the introduction of those of other individuals, with the inevitable effects which these produce upon the common environment, the public health problems with which we have to deal are by no means either simple or easy of solution. We need in the first place a precise knowledge of the quantity of life (that is, the *population*) with which we have to deal, and if over against this we set the total amount of dying within a particular period and then determine the death-ratio (or *death rate*), we shall have at least a crude and general measure of the sanitary condition of the community. But if we determine simply the general death rate, we shall not have gone far enough, for it is now well understood that the death rate is profoundly influenced by factors other than disease, such for example as the *birth rate*, a high birth rate naturally leading under present conditions to a high death rate. It becomes necessary then in any scientific examination of public health problems to go behind the general death rate and to study other conditions. One of the most important of these is the so-called *specific death rate*, that is to say, the death rate in any given population from particular diseases such as tuberculosis, typhoid fever, pneumonia and the like; for it not infrequently happens that in the presence of a fair general death rate the mortality from typhoid fever (for example) may be excessive. In determining *population* the census is of the first importance (see CENSUS) and a well-directed census should furnish not merely the total number of the living but the «age periods» of the population, inasmuch as the mortality at different ages varies widely, and no safe conclusions concerning the sanitary conditions of a population can be drawn without careful reference to the constituents of that population at the different age-periods. Space will not permit here a detailed treatment of the sources of error to which students of sanitation, morbidity, death rates and the public health are exposed in various other directions, but which reference to any of the leading works upon vital statistics will readily disclose.

Epidemics.— From the practical point of view there is no more interesting subject connected with the public health than the rise, progress and decline of epidemics, the study of which now forms a special science known as epidemiology. From time immemorial civilized communities have been ravaged by plagues, pestilences and epidemics, which have at times enormously increased the death rate, as in the famous black death (see BLACK DEATH; PESTILENCE; PLAGUE), and have thus made serious inroads upon the public health. With the disappearance (until the Great War) of such diseases as typhus (ship fever, jail fever) and of scurvy, both of which formerly destroyed thousands even among civilized peoples, attention has of recent years been fixed more particularly upon the bubonic plague, which after a long absence from Europe has reappeared in great intensity in China and India, and has even threatened the shores of England and the United States. Asiatic cholera, which made a dramatic although brief appearance in the great commercial city of Hamburg, Germany, in 1892 has since been kept at bay in civilized countries. Typhoid fever, however, still remains a curse of some even highly civilized communities, largely owing to the fact that it is readily conveyed by food and drink, such as oysters, milk and water, while its specific germs appear to be more than usually hardy or resistant. But with the discovery of an effective serum or vaccine capable of conferring immunity against typhoid fever, the dread of this disease is largely done way. Tuberculosis popularly called «the great white plague,» and which has always been credited with a very large proportion of the total mortality in all communities, still destroys perhaps larger numbers of people than any other one disease. Probably there was never a time (except perhaps in the middle of the 19th century in Great Britain) when a more general scientific, professional or popular interest has been felt in public health problems, and especially in the particular disease last mentioned, than to-day. As a result of the immense progress which has been made in our knowledge of the methods of dissemination of infectious and contagious diseases; and doubtless also in part because of the general improvements which the 19th century has witnessed in housing, heating and ventilation, and the better protection of the health of individuals as well as communities, a distinct decline in the death rate is apparent and a correspondingly greater longevity. It is impossible to determine how much influence should be credited to general improvements, the result of a higher degree of civilization, but after making all deductions it probably still remains true that life is safer and longer to-day than ever before, largely because of a better knowledge of the causes of disease and a better practice of the arts of hygiene and sanitation among the people. The discoveries which have been made in respect to the principal infectious and contagious diseases affecting the human race within the last 50 years have been so extensive and so extraordinary that the names of these diseases have become almost household words, and the methods of dealing with them have become familiar, not only to physicians, but to sanitary experts, trained nurses and the intelligent public in general; and inasmuch as knowledge of this sort lies at the basis of effective promotion of the public health, we may briefly describe the more marked features of some of these diseases and especially the methods of their dissemination and control.

Before we do this, however, we may point out the remarkable fact that certain diseases which only two or three centuries ago ravaged the human race have been to-day almost completely exterminated from the higher civilizations. The most important of these is probably the *bubonic plague*, which in one form or another appeared in Europe down to the 19th century under the various names of the black death, the plague and pestilence. This disease is characterized (among other features) by swelling of the lymphatic glands, which turn black and suppurate, being then known as buboes, but it was not until the last decade of the 19th century that these buboes were found to be loaded with microbes (bacilli) capable of producing the disease in certain of the lower animals. Very late in the 19th century this plague, which had previously been for many years almost unknown in Europe and had never, so far as known, visited America, suddenly spread both westward and eastward from China, and menaced the coasts of Europe and America. It has, however, for the most part been successfully held in check, and is no longer greatly dreaded. Its method of dissemination is believed to be by means of rats and fleas, rats being very susceptible to the disease, and fleas which have bitten rats being abundantly capable of transferring the bacilli to human beings.

Another disease formerly very prevalent in highly civilized communities, which has within the last century or two practically disappeared, is *typhus fever* (spotted fever, jail fever, ship fever, etc.). This disease, which for a long time was not separated from typhoid fever in classifications, and which resembles it closely, but differs from it in the fact that it frequently causes extensive eruptions and is also lacking in the characteristic ulceration of the bowels which is the distinctive feature of typhoid fever, was formerly greatly dreaded, but, doubtless owing to the improved sanitation (greater cleanliness) of crowded places such as jails and ships, has practically disappeared from among the most highly civilized peoples. How far better food and air have aided in the good work it is impossible to say. The main factor, however, is greater cleanliness, for it is now known that this disease is transmitted by lice, and that freedom from lice means, as a rule, freedom from typhus fever.

Smallpox, a disease formerly so prevalent that, according to one authority, "scarce one in a thousand escaped it," and so much dreaded that the pesthouse in the early American towns and cities, a constant as well as a repulsive feature, was regarded almost with terror by many of the inhabitants, has of late years been nearly exterminated in the most highly civilized countries, and wherever sufficient pains have been taken to hold it in check by means of vaccination and revaccination. In the German army, for example, this disease is now extremely rare, apparently for the reason that vaccination and revaccination are most carefully attended to. The only serious danger from smallpox to-day is that communities which because of its scarcity are unfamiliar with the horrible character of the disease and its ravages may come to rely upon improved sanitation or other supposed safeguards and neglect vaccination which, according to all experience, is the only trustworthy defense against this extremely infectious and contagious disease. This danger is aggravated somewhat by the mistaken zeal of the so-called anti-vaccinationists, who, fixing their attention upon the occasional injuries consequent upon vaccination rather than upon the enormous saving of life which has resulted from its use, maintain a propaganda against it, and seek to have vaccination entirely done away. However earnest and honest these persons may be, there can be no doubt in the minds of those who will take the trouble to review all of the evidence, that their contentions are largely unfounded.

Typhoid fever, a diarrhœal disease, ever since its clear recognition, about 1840, as a malady distinct from typhus fever, has gradually come to be recognized as one of the most insidious diseases of civilized societies. Its ravages among the uncivilized are doubtless excessive, and even among highly civilized societies it is far more frequent than it ought to be, apparently because the bacilli which characterize and cause the disease are capable of maintaining their life outside the human body in the environment of man for a somewhat longer period and under somewhat more trying circumstances than are the germs of many other diseases. These bacilli are, for example, fairly resistant to cold and to dryness, and, although they are not known to produce spores, they are apparently able to persist for a long time (in greatly diminished numbers) in sewage, water, ice and upon fruits, vegetables and other articles of food. In milk under certain circumstances they may even multiply, and a very large number of epidemics of typhoid fever has been traced to infected milk. The same thing is true of drinking-water, and, since 1894, when an extensive epidemic of this disease, due to infected oysters, occurred among the students and others in Wesleyan University, in Middletown, Conn., many investigations have been made, both in Europe and in America, tending to show that raw oysters are not infrequently grown near the mouths of sewers and that such oysters may readily convey the germs of this disease. Furthermore, since it has become known that the bacilli of typhoid fever occur not only in the bowel discharges, but also in the urine, and even in the sputum of persons sick of this disease, it has become easy to understand the fact that it is often really, as well as apparently, contagious, although of course in far less degree than the eruptive diseases, such as smallpox, measles and scarlet fever. The control of typhoid fever is now largely within our power, for it has been shown by experience, in armies and navies, that it can be mostly avoided by "vaccination" with a serum made from the dead bacilli of the disease itself.

Malaria and malarial fever had long been associated in the popular mind with swamps, but until 1880 no germ characteristic of these diseases (which are really one and the same) had been discovered. In that year Laveran, a French investigator in Algiers, discovered in the red blood-cells of persons sick of the disease certain animal parasites, protozoan in character, which appear to be not only the constant accompaniment, but the sufficient cause of the disease. Quite recently Ross in England, Celli in Italy and various other observers have proved beyond doubt that these germs are conveyed from one human being to another by means of certain female mosquitoes, belonging to the genus *Anopheles*, without the bite of one of which containing the microbes the disease does not appear to be transferable. The life history of these parasites has been worked out thoroughly, and to-day it is universally believed that malaria is caused by the parasites mentioned above, which spend only a portion of their normal life in their human host, and the remaining portion in the bodies of mosquitoes of the genus *Anopheles*. The importance of this discovery can scarcely be overestimated, for although formerly, as already stated, malarial fever was associated with swamps, no one could tell precisely how; while to-day it is easy to see that if swamps contain infected malarial mosquitoes they may be dangerous sources of disease for human beings. On the other hand, it had long been observed that it was not swamps *per se* which produced malaria, inasmuch as thousands of swamps had never been brought under suspicion. This circumstance is now interpreted as due to the fact that whatever mosquitoes may have been present in the swamps in question must have been of some other genus incapable of transmitting the disease; or else, if of the right genus, then these *Anopheles* had never become infected by biting human beings suffering with malaria. The practical importance of these discoveries in regard to malaria cannot easily be exaggerated, for malarial fever has long been the dreaded pest of the engineer, and such enterprises as the digging of the Panama Canal had been enormously hampered and even prevented by the prevalence of malarial and other fevers. Nowadays it suffices to make sure that all sleeping huts or houses are covered with nettings which shall keep out mosquitoes, and that if possible the breeding places of these pests shall be either drained and altogether done away or else petrolized, that is, treated with oil of some sort which shall interfere with the breeding of mosquitoes.

Tuberculosis has long been recognized as one of the worst diseases afflicting the human race. It is characterized by certain cheesy masses called tubercles, which may be formed either in the lungs or upon the membranes of the brain, in the lymphatic glands or even within the tissues of the face, the disease in this last case being known as *lupus* (a wolf), and causing serious disfigurement. In 1882 Dr. Robert Koch discovered within these cheesy masses small microbic rods or bacilli to which he gave the name by which they are now universally known, of the *Bacillus tuberculosis*. These bacilli frequently occur in the sputum of tuberculous patients, and if this sputum is cast out upon the streets or in public places, it may become dried and disseminated in various ways, for example in dust. The bacilli are believed to be disseminated also by the coughing of fine moist particles from the lungs of tuberculous patients into the air; by milk derived from the tuberculous udders of tuberculous cows; by kissing — as when, for example, a tuberculous mother kisses her young child; by the hands,— as when a tuberculous patient, coughing upon his hand, afterward, without having washed it, touches the hand of another, or articles of food which are eaten raw; and in a great variety of other ways. Here also much is being done by boards of health and other sanitary organizations which seek to control the spitting nuisance; by physicians who educate tuberculous patients to use destructible spit-cups, handkerchiefs and the like; by sanatoria, that is, establishments intended especially for the benefit and cure of cases of *incipient* tuberculosis, and by a campaign of education consisting largely in the distribution of literature bearing upon the disease. Among the most noted sanatoria for tuberculosis in the world are those at Davos Platz, in the Italian Alps, and at Saranac Lake, in the Adirondacks. More recently State sanatoria have begun to be established, the first in America being that of the State of Massachusetts, at Rutland, Mass. It was formerly thought necessary for incipient tuberculous cases to be removed to Colorado or other high, dry localities, but to-day it is commonly felt that, however, desirable a removal of this kind may sometimes be, it is not always wise, and that the essentials of a good sanatorium (which are largely rest, fresh air and good feeding) may often be found near a large city, the first institution of this kind to be established (namely, the Sharon Sanatorium at Sharon, Mass., only 16 miles from Boston, upon a slight elevation and a dry, sandy soil) having proved eminently successful.

Diphtheria, or malignant sore throat, has of late years come, unhappily, to be quite common, and is rightly much dreaded. The causative germ of the disease was discovered and described by Loeffler, a pupil of Koch, in 1884, since which time it has been very widely studied, and has been found to do its damage by producing in the bodies of its victims, or even when growing in beef tea, a highly poisonous substance known as its toxin. Until 1892 no remedy for it was known, but in that year von Behring of Germany announced the discovery of that remarkable antidote for the disease, now universally known as diphtheria *antitoxin*. Behring was led to his magnificent discovery by reflecting upon the fact that some animals can be immunized to diphtheria toxin and that the blood of such immune animals is capable of neutralizing the poisonous character of the toxin produced by the germs of diphtheria. The manufacture of diphtheria antitoxin is now a large industry, sometimes carried on under private and sometimes under State or municipal control. There can be no question that its use has largely diminished the mortality from this disease.

There are many other diseases such as yellow fever, leprosy, scarlet fever, measles and pneumonia, a knowledge of which has of late years become more precise and practical, but these cannot be referred to within the limits of this article.

Some Methods for Health Improvement. — Engineering enterprises, such as drainage and sewerage, water supply, the filtration of water, the purification of sewage, the cleaning of streets, and garbage collection and disposal, have had much to do in the past, and will doubtless have much to do in the future, with improvement of the public health; and there is every reason to hope that the general death rate may continue to diminish, as it has diminished, in the past, largely by virtue of these enterprises. In addition, however, much remains to be done; the more crowded sections of cities — the so-called slums — require the most careful supervision to prevent overcrowding, bad ventilation and accumulation of noxious or even toxic wastes. The milk supplies of cities are as yet very largely in a primitive state so far as the production of milk is concerned, and it will become necessary in the near future either to improve radically the conditions of its production or else to abandon almost altogether the use of uncooked milk. Vegetables, fruits and berries, which are eaten in the raw state, such as celery, lettuce, radishes, watercress, cherries and strawberries are peculiarly exposed to infection either by handling or because they are occasionally treated with manure-water during the process of growth, and such water is not infrequently polluted and infected. The dangers from oysters have already been referred to. How far uncooked or underdone meats are dangerous is uncertain, although it is well known that uncooked ham and other lean meat of hogs has frequently caused trichinosis, an infection due to minute parasitic worms.

Illuminating gas, particularly water gas, which contains a large percentage of carbonic oxide (CO), has an important bearing on the public health, not when properly burned or by its products of combustion, but because of leaks in the mains or the service pipes, or about the fixtures by which it is distributed. Many deaths occur annually from this source, and the use of water gas should be accompanied by special precautions.

As for the effect of *public gymnasia, playgrounds* and other open places in cities or other crowded communities little need be said, inasmuch as it is impossible to determine their precise value. There can be no question, however, as to the general wisdom or advantage of such things in modern cities. Isolation hospitals for infectious diseases are gradually being established in our larger cities, and are filling a long-felt want. Best of all, the recent improvements in transportation are making it possible for large numbers of persons to live near, rather than within, cities and suburban life is becoming as characteristic a feature of modern life as is city life itself. Unfortunately this remedy for the evils of city life applies only to the fairly well-to-do, for the very poor will probably always find it easier, cheaper and more exciting to live closely crowded in the congested centres of population, where work is most abundant and where the incidental diversions of a varied and noisy city life may be had free of cost.

The public health problem is very largely, but not exclusively, a problem of the life of crowded communities. Yet something needs to be said concerning the *sanitation of farms* which, while they ought to be the most healthful places in the world, are by no means always such. Damp or even wet cellars, bad ventilation, overheating and poor feeding; defective sanitary arrangements, shaded houses and unwholesome surroundings, or close association with domestic animals, such as dogs, cats and poultry or swine, too often make farm life unsanitary, and boards of health having in charge the sanitation of States or Territories should give attention to these problems as well as to those of more crowded communities. *Railway sanitation, steamship sanitation*, and the more technical aspects of the work of boards of health, such as *disinfection, scavenging, quarantine, isolation, vaccination* and the like, are nowadays subjects of great public consequence and are fully treated in special works or memoirs, reference to some of which will be found at the end of this article.

There are few more interesting matters relating to the public health than the control of the adulteration of foods and drinks. In spite of the increase of general intelligence, flaming advertisements of quack medicines too often disfigure the pages of the newspaper press and testify to the enormous use of patent medicines, drugs, etc., by the public at large. In many States special laboratories are maintained for the investigation of foods and drinks, and stringent laws exist for the regulation of their adulteration and sale. One of the most striking facts which these have disclosed is that many of the so-called compounds, tonics, sarsaparillas and other patent foods or medicines are rich in alcohol, some of them containing as much alcohol as many kinds of wine or beer. Some which profess to contain certain ingredients are totally lacking in them, and others which profess to cure the alcohol habit or the morphine habit actually contain alcohol or morphine respectively, occasionally in large quantities. The revelations which proceed from these State laboratories are sometimes startling, and any one interested in the public health should inform himself upon this subject, as he may readily do by turning, for example, to the 'Annual Reports of the State Board of Health of Massachusetts.'

State and Municipal Laboratories are thus an important and modern adjunct to the public health work of boards of health. In the best of these means are provided for the rapid and certain diagnosis of doubtful cases of diphtheria, typhoid fever, malaria, hydrophobia, glanders, anthrax and some other infectious diseases. In them also analyses of milk, water, ice, sewage, vinegar and other liquids, of illuminating gas and of air, and of substances subject to infection or adulteration may be made; foods and drinks may be examined; materials for pavements or buildings may be tested and a great variety of useful operations conducted, all tending to a better knowledge of local sanitary conditions. It is doubtful if any arm of the public health service is to-day more important than this. Largely in consequence of all these and many other efforts now making for the improvement of the public health, human life is probably to-day safer and healthier than it has ever been before, and the outlook for further progress is very bright. See HYGIENE; HYGIENE, MILITARY; SANITARY SCIENCE AND PUBLIC HEALTH; SANITARY ENGINEERING.

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Students, Physicians and Medical Officers’; Rosonau, ‘Preventive Medicine and Hygiene’; Palmberg, ‘Treatise on Public Health and Its Applications in Different European Countries’; Blyth, ‘Manual of Public Health’; Abbott, ‘Hygiene of Transmissible Diseases’; Baker, ‘Municipal Engineering and Sanitation’; Chapin, ‘Municipal Sanitation in the United States’ and ‘Sources and Modes of Infection’; Annual Reports of the State Boards of Health of Massachusetts and Connecticut; Monthly Bulletins of the State Boards of Health of Massachusetts, Connecticut, Vermont, Michigan, etc. The principal periodicals are *Public Health Reports* (Washington, D. C.); *Public Health* (London); *The Journal of State Medicine* (London); *Journal of the Sanitary Institute* (London); *Revue d'Hygiène* (Paris); *Zeitschrift für Hygiene und Infectionskrankheiten* (Leipzig); *Archiv für Hygiene* (Munich and Berlin); *Deutsche Vierteljahrsschrift für öffentliche Gesundheitspflege* (Brunswick); *The American Journal of Public Health; The Journal of Infectious Diseases*, etc. Consult also Whipple, G. C., ‘Vital Statistics’; MacNutt, J. S., ‘A Manual for Health Officers’; ‘Annual Reports of the Rockefeller Foundation (International Health Board), etc.

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PUBLIC HYGIENE. See Social Hygiene.

PUBLIC LANDS. The expression “public lands” or “public domain” of the United States, is used to include such lands of the United States as are subject to sale or other disposal under general laws and are not reserved or appropriated for any special public purpose. This article will treat of the entire area which at any time has been included in the public lands of the United States.

The table below shows for the several States and the Territory of Alaska the total area in acres and the areas unappropriated and unreserved on 30 June 1915 subdivided into those which have been surveyed, those which have not been surveyed and the total area.

Unappropriated public lands are subject to disposition under general laws, the principal of which are the Homestead Law (q.v.), the Desert Land Law (q.v.), the Timber and Stone Law (q.v.), the Reclamation Laws (q.v.) and the Mineral Laws (q.v.).

The public lands of the United States were acquired by treaty, purchase and occupation. By the Articles of Confederation agreed to in Congress 15 Nov. 1777 and ratified by the several States in the four subsequent years the government of the United States of America was organized and pursuant to that action took possession and control of the unappropriated Crown lands of Great Britain as the successor of that government. By the definitive treaty of peace concluded 3 Sept. 1783 Great Britain formally relinquished all its “propriety” (proprietary) and territorial rights, leaving the ownership of the United States and of the several States undisputed.

Public Lands Surveyed and Remaining Unsurveyed.

State or Territory	Public Lands Surveyed and Remaining Unsurveyed				Public Lands Unappropriated and Unreserved on 30 June, 1918, and Available for Acquisition		
	Land area	Surveyed during fiscal year ending 30 June 1918	Surveyed to 30 June 1918	Unsurveyed to 30 June 1918	Surveyed	Unsurveyed	Total
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Alabama	32,818,560	12	32,818,560	....	35,220	....	35,220
Alaska	378,165,760	183,225	1,046,479	377,119,281	1,060,760	351,275,000	352,281,760
Arisona	72,838,400	1,504,874	29,265,516	43,572,884	6,829,800	14,426,210	21,256,010
Arkansas	33,616,000	....	33,616,000	....	281,436	7,040	288,476
California	99,617,280	199,700	80,579,460	19,037,820	15,900,150	4,628,884	20,529,034
Colorado	66,341,120	154,837	63,563,461	2,777,659	8,441,461	1,830,494	10,271,955
Florida	35,111,040	1,201	30,934,070	4,176,970	114,726	....	114,726
Idaho	53,346,560	993,080	34,875,857	18,470,703	8,167,725	5,154,991	13,322,716
Illinois	35,867,520	....	35,867,520	....	....	....	....
Indiana	23,068,800	....	23,068,800	....	....	....	....
Iowa	35,575,040	....	35,575,040	....	....	....	....
Kansas	52,335,360	....	52,335,360	....	5,275	....	5,275
Louisiana	29,061,760	....	29,061,760	....	33,649	11,910	45,559
Michigan	36,787,200	6	36,787,200	....	72,829	....	72,829
Minnesota	51,749,120	185	49,828,091	1,921,029	469,973	....	469,973
Mississippi	29,671,680	....	29,671,680	....	42,064	....	42,064
Missouri	43,985,280	....	43,985,280	....	147	....	147
Montana	93,568,640	1,902,254	74,487,300	19,081,340	3,335,963	4,865,056	8,201,019
Nebraska	49,157,120	....	49,157,120	....	105,909	2,647	108,556
Nevada	70,285,440	1,104,190	44,088,656	26,196,784	31,848,173	23,234,027	55,082,200
New Mexico	78,401,920	1,076,386	59,357,545	19,044,375	13,692,216	5,423,338	19,115,554
North Dakota	44,917,120	409	42,987,788	1,929,332	116,138	....	116,138
Ohio	26,073,600	....	26,073,600	....	....	....	....
Oklahoma	44,424,960	25	44,424,960	....	31,715	....	31,715
Oregon	61,188,480	194,157	52,768,830	8,419,650	13,369,819	955,772	14,325,591
South Dakota	49,195,520	32,552	48,772,628	422,892	793,040	44,186	837,226
Utah	52,597,760	1,057,881	32,773,465	19,824,295	14,010,343	17,465,576	31,475,919
Washington	42,775,040	202,099	34,581,078	8,193,962	931,872	328,111	1,259,983
Wisconsin	35,363,840	21	35,363,840	....	6,146	....	6,146
Wyoming	62,460,160	71,775	58,779,547	3,680,613	23,595,511	1,838,683	25,434,194
Total	1,820,366,080	8,678,869	1,246,496,491	573,869,589	143,238,060	431,491,925	574,729,985

Note.— Definite reports regarding the areas disposed of in Alaska have not been published but the amount is probably less than 200,000 acres.

During the existence of the government under the Articles of Confederation, Congress on 6 Sept. 1780 passed a resolution recommending the surrender and disposal by the several States of their waste and unappropriated lands to aid in paying the public debt incurred by the War of the Revolution. These lands lay to the west of the present boundaries of the then existing States.

In 1781 New York ceded without reservation 202,187 acres now in the county of Erie, Pa. In 1784 Virginia ceded 169,559,680 acres north of the Ohio and east of the Mississippi rivers and known in subsequent legislation as the «Northwest Territory,» reserving therefrom 150,000 acres for the benefit of George Rogers Clark and the officers and soldiers who aided him in his successful expedition into that country against the British and also so much of 3,800,000 acres in Ohio as should be needed to satisfy certain donations to her Revolutionary soldiers. There were other minor stipulations.

In 1785 Massachusetts ceded, without reservation, 34,560,000 acres, which now forms a part of southern Michigan and Wisconsin and northern Illinois.

In 1786 Connecticut ceded 26,600,000 acres, which now forms the northern parts of Ohio, Indiana and Illinois; reserving, however, 3,800,000 acres, a strip in northern Ohio 120 miles long, which was afterward known as the «Western Reserve» and of which Connecticut donated 500,000 acres, subsequently known as «Fire Lands,» to certain of her citizens who had suffered loss by fire and raids during the Revolutionary War.

The remainder of the lands reserved by Connecticut were sold to a company for $1,200,000.

In 1787 South Carolina ceded, without reservation, 3,130,000 acres, a strip 15 miles wide which now forms the northern parts of Georgia, Alabama and Mississippi; while in 1790 North Carolina ceded 29,184,000 acres, which now forms the State of Tennessee, reserving the right to satisfy therefrom certain donations made to her soldiers and other claims under its land laws, which absorbed the bulk of the lands embraced in her cession.

In 1802 Georgia ceded 56,689,920 acres, now forming parts of Alabama and Mississippi, in consideration of the payment to her of $1,200,000 and the satisfaction of certain outstanding obligations known as the «Yazoo Claims,» the settlement of which finally cost the United States $5,000,000.

By treaty of 30 April 1803 France ceded 757,961,920 acres, now known as the «Louisiana Purchase,» the government paying therefor $27,267,621, which includes the original price of $15,000,000, interest, settlement of claims, etc. These lands now constitute a part of Mississippi, Alabama, Texas, Colorado, Wyoming, Montana and the States lying between them and the Mississippi River.

By treaty of 22 Feb. 1819 Spain ceded 37,931,520 acres, now constituting the State of Florida, at a total cost of $6,289,768.

By treaty of 2 Feb. 1848 Mexico ceded 334,443,520 acres, now constituting the States of California, Nevada, Utah and parts of New Mexico, Arizona, Colorado and Wyoming, at a cost of $19,250,000.

On 25 Nov. 1850 Texas ceded 61,892,480 acres, now constituting a part of New Mexico, Oklahoma and Colorado, for $16,000,000.

By treaty of 30 Dec. 1853 Mexico ceded 29,142,400 acres, known as the «Gadsden Purchase,» now part of New Mexico and Arizona, for $10,000,000.

By treaty of 30 March 1867 Russia ceded all of Alaska, embracing 378,165,760 acres, for $7,200,000.

On 7 July 1898 the Territory of Hawaii was acquired, containing 4,127,360 acres. By treaty of 10 Dec. 1898 Spain ceded Porto Rico, containing 2,198,400 acres; Guam, 134,400 acres, and the Philippine Islands, containing 73,573,120 acres, for $20,000,000.

By treaty of 2 Dec. 1899 with Germany and Great Britain, Tutuila and other small Samoan islands, containing in all 49,280 acres, were annexed.

By treaty of 7 Nov. 1900 Spain ceded Sibutu and other small islands in the vicinity of the Philippines, containing in all 43,520 acres, for $100,000.

The Oregon Country, containing 183,480,960 acres and embracing Oregon, Washington, Idaho and part of Montana, was claimed by the United States through discovery and exploration and that claim was afterward recognized by England and Spain.

A controversy with Great Britain regarding the northern boundary west of the Rocky Mountains was not settled until the treaty of 15 June 1846, which, however, left undetermined the extreme western end of the boundary line at its junction with the Pacific Ocean.

The treaty of 8 May 1871 provided, among other matters, that the decision of this point should be left to the emperor of Germany, who decided in favor of the contentions of the United States, 21 Oct. 1872.

The total area of the acquisitions by State cessions was about 500,000 square miles or 320,000,000 acres at a cost of $22,200,000. The area acquired from foreign governments, including the Oregon Country, was about 2,400,000 square miles or about 1,500,000,000 acres, at a cost of $65,957,389.98. In addition to these costs, which include interest and settlement of private claims, the United States has paid more than $200,000,000 for extinguishing the rights of the Indians to these lands.

In forming new States from the territory obtained through these cessions from States and foreign governments, Congress has required each new State to adopt an irrevocable ordinance that the State shall not tax the public lands nor pass laws to interfere with the primary disposal thereof by the United States.

The public lands of the United States were, in the beginning, regarded as an asset for the payment of the debt incurred in carrying on the War of the Revolution. Many plans for disposing of the lands were proposed and considered. The earliest efforts were to sell the land in large blocks and prior to the organization of our present government Congress made three such sales. The first was the sale to the Ohio Company. This was originally intended to cover 2,000,000 acres at $1 per acre, the land lying in the present State of Ohio on the Scioto and Ohio rivers. The area was reduced to 822,900 acres and the sale was confirmed 27 July 1787. The amount actually received was two-thirds of a dollar per acre and payment was made in certificates of the public debt.

The second sale was to John Cleves Symmes, finally confirmed by the Act of 5 May 1792. The lands lie in the present State of Ohio on the Ohio River, between the Great and Little Miami rivers, near the site of Cincinnati. The tract was supposed to contain 1,000,000 acres, but its actual area was 248,540 acres. This was sold at the same rate of two-thirds of a dollar, paid in certificates of the public debt and military land warrants.

The third sale was to the State of Pennsylvania, a tract now in Erie County, containing 202,187 acres, ceded to the United States in 1781 by New York. This was sold at the same rate and paid likewise in certificates and military land warrants.

By the Act of 2 March 1799 those who had made contracts with Symmes for lands not lying within his purchase, as finally determined, were allowed to buy the lands contracted for at $2 per acre, payable in certificates of the public debt. About 88,880 acres were sold under this law.

Practically the first act of general character for the sale of lands was passed 18 May 1796 and related to a tract in the present State of Ohio. This provided for a system of rectangular surveys substantially as now in use. Townships were laid off six miles square containing 36 sections, each being one mile square and having an area of 640 acres. Alternate townships were to be subdivided into sections, while only the exterior boundaries of the others were laid out on the ground.

The subdivided townships were to be sold in tracts not less than one section or 640 acres each. The other townships were to be sold in tracts not less than a quarter township, excluding the four middle sections which were reserved for future disposal, thus having a block of eight sections in each quarter township, so that these lands were to be disposed of in tracts of 640 acres and 5,120 acres, respectively.

The sales were to be made to the highest bidder at a public sale, but no sale was to be made for less than $2 per acre. One-half was to be paid within 30 days and of this one-tenth was required at the time of sale, with one year's credit for the remaining half. The land was forfeited in case of failure to pay the balance. A discount of 10 per cent was allowed on one-half the amount if the whole sum were paid within 30 days.

By the Act of 3 March 1797, passed the next year, the lands sold after that date could be paid for in evidences of the public debt.

The Act of 1796 remained in force for four years without producing very satisfactory results, only 121,540 acres having been disposed of.

The total area sold prior to the Act of 10 May 1800 was 1,484,047 acres for $1,201,725.68, an average price of less than 81 cents per acre. This includes some small tracts sold before the organization of our present government at the minimum prices of $1 and two-thirds of a dollar.

The Act of 1796 established the office of surveyor-general with substantially the same duties as that officer now exercises. The sales were made under the supervision of the Secretary of the Treasury. The smaller tracts were sold under the direction of the governor or secretary of the Western Territory and the surveyor-general at Cincinnati or Pittsburgh according to districts defined by the act. The quarter-township tracts were sold by the Secretary of the Treasury at Philadelphia, then the seat of government.

The Act of 10 May 1800 made further provision for the sale of lands in the present State of Ohio, modifying in several important particulars the Act of 1796.

Four land districts were designated each under the administration of a register and a «Receiver of Public Monies» with substantially the same functions as at present. Their offices were established at Cincinnati, Chillicothe, Marietta and Steubenville. Provision was also made for a receiver at Pittsburgh. Thus by 1800 there had been established substantially our present system of the surveys of the public lands under the supervision of a surveyor-general for a specified district and a system of sale by a register for each land district, not necessarily the same as the surveyor-general's district, and the receipt and accounting for funds by a receiver of public moneys for each district. New land offices were opened and new offices of surveyor-general were established from time to time as they became necessary.

Under the Act of 1800 the lands were offered at public sale in sections and half-sections for not less than $2 per acre, payable in cash or in evidences of the public debt. One-fourth of the price was to be paid within 40 days, one-fifth of that or one-twentieth of the whole, was required at the time of sale. The other three-quarters were payable in two, three and four years, respectively, with interest at 6 per cent per annum. A discount of 8 per cent per annum was allowed for advance payments. Provision was made for forfeiture and resale in case of default. The lands remaining unsold after having been offered for sale could be purchased at private sale for $2 an acre.

The surveyor-general was authorized to lease the lands reserved for future disposition, in sections and half-sections, for terms not exceeding seven years. The act also provides that any person who has erected or has begun to erect a grist-mill or saw-mill upon the lands to be sold was «entitled to the preemption» or preference right to purchase the section on which it was located at $2 per acre.

Before 1789 deeds for the lands sold were executed by the Board of Treasury, corresponding to our present Treasury Department, or by the loan commissioners, agents of this board. After that date all patents for the lands sold were executed by the President, countersigned by the Secretary of State and recorded in his office. It is to be noted that in a few cases Congress had made grants of lands in such terms that patent was not required, title passing directly by virtue of the act.

By Act of 25 April 1812 the General Land Office was established in the Department of the Treasury. To this office were transferred all the duties relating to the survey, sale and patenting of the public lands previously performed by the Secretary of War and the Secretary and Register of the Treasury. All patents for lands were to be issued in the name of the United States under the seal of the new office, signed by the President and countersigned by the Commissioner of the General Land Office.

To relieve the President of the great burden of personally signing the large number of patents issued, Congress by Act of 4 July 1836 authorized the President to appoint, by and with the advice and consent of the Senate, a secretary whose duty it would be to sign land patents in his name. This statute continued in effect until 19 July 1878 when the President was authorized to designate an executive clerk to perform this duty, instead of submitting a nomination for confirmation by the Senate.

The General Land Office became part of the Department of the Interior when the latter was organized 3 March 1849.

After the Act of 1800 the sales of public lands continued without material change in system but with gradual improvements in detail. As each new area was opened to sale, the existing system was extended to it providing for sale at public auction with the right of purchase at private sale after the period of public offering, usually three weeks, part payment in cash and the balance in four years.

Prior to the Act of 26 March 1804 the lands were offered for sale in not less than half-sections (320 acres). By that act the survey and sale of lands in quarter-sections (160 acres) was authorized. Before that time payment of surveying expenses and patent fees had been required, but was discontinued by that act.

Payments for land in evidences of the public debt were authorized by all the general land laws until the passage of the Act of 3 March 1803, which provided that in the purchase of the lands in Mississippi Territory, being the lands lying south of the State of Tennessee, such payments could not be made. The Act of 18 April 1806 discontinued such payments as to all public lands thereafter sold.

The Act of 24 April 1820 made a radical change, however, requiring immediate payment in full for all sales made from and after 1 July 1820. The credit system had been demoralizing. Congress had been constantly importuned to extend the time for payment and acts for this purpose were passed at nearly every session. The privileges of these acts were limited to persons who had purchased not more than 640 acres. After 1820 such acts were passed nearly every year until the passage of the Act of 23 May 1828, which provided for the issue of certificates to represent the money paid for land which had reverted to the United States because of failure to complete the payments. These certificates were receivable in payment on the purchase of other lands within the same State or Territory.

This act was followed by the Act of 31 March 1830 and the Act of 9 July 1832 providing for further relief in such cases, closing the long series of enactments for the relief of credit purchasers.

The total amount of land sold under the credit system was about 19,400,000 acres for about $47,700,000. This was scaled down by the operation of legislation, by reversions and by relinquishments to about 13,600,000 acres and the receipts were about $27,900,000, an average of a little more than $2 per acre.

The Act of 24 April 1820 made other important changes than requiring cash payments. It provided that from and after 1 July 1820 all public lands should be offered for sale in half-quarter sections, or 80-acre tracts. This had not been previously permitted except in six designated sections of each township, authorized by the Act of 22 Feb. 1817. When disposed of at private sale the purchaser had the option of buying as much as a section (640 acres). The Act of 1820 also fixed the minimum price, whether at public or private sale, as $1.25 per acre. The act also provided that public sales should be kept open for two weeks.

By the Act of 5 April 1832 the sale of quarter-quarter sections, or 40-acre tracts, was authorized.

In pursuance of the early policy for the sale of the public lands in large blocks every effort was made to prevent settlement on the lands prior to purchase.

On 15 June 1785 Congress, under the Articles of Confederation, passed a resolution forbidding settlement on the public domain. Other warnings were given in various ways. The Act of 3 March 1807 prohibited such settlement under penalty of forfeiting any right or claim that the settler may have, and the President was authorized to use the civil and military forces to remove such persons from the lands. An exception was made in favor of settlers prior to the passage of the act who, upon application to the local land office, could obtain permission to occupy the lands as tenants at will, but must remove from them when a sale was made.

On 25 March 1816 a similar privilege of temporary occupation on application was given to all who had settled upon public lands prior to 1 Feb. 1816. The right to make such application was to continue for one year from the date of the act. On 3 March 1817 Congress extended this time to 3 March 1818, and on 20 April for another year.

Meanwhile the difficulty of preventing settlement prior to sale, and the gradual abandonment of the idea of obtaining a large revenue from the sale of the lands, due no doubt to the increasing prosperity of the nation, induced the policy of encouraging settlement and home-making upon the public lands. Pre-emption entries based upon settlement were accordingly authorized from time to time for certain specified areas.

The first right of pre-emption or preference right was given by the act of 2 March 1799 in favor of those who had made contracts with Symmes or his associates for lands which were not included in the area patented to them. This right was not based upon settlement, and the Act of 10 May 1800 was the first to give such a right based upon occupation of the land, namely, to those who had erected or had begun to erect a gristmill or a sawmill in the Ohio country before the passage of the act.

From time to time acts were passed providing for pre-emption rights within certain areas and subject to varying conditions. By 1830 a large part of the public land was comprehended within the operation of these acts.

On 29 May 1830 the first pre-emption act of general application was passed, allowing entry by those who had settled on the land before that date, and remaining in force for one year.

On 5 April 1832 «all actual settlers, being housekeepers upon the public lands,» were allowed the right to enter, within six months after the passage of the act, a tract not exceeding 80 acres, to include their improvements. By various subsequent enactments these provisions were continued in force until the passage of the general Pre-emption Act of 4 Sept. 1841.

This act provides that «every person being the head of a family, or widow, or single man, over the age of 21 years, and being a citizen of the United States, or having filed his declaration to become a citizen,» who since 1 June 1840 has made, or shall thereafter make, settlement in person on surveyed public land and shall live upon and improve the same, may enter not exceeding 160 acres at the minimum price of $1.25 per acre. No person was entitled to make more than one such entry, nor could any one make such entry who was the owner of 320 acres of land.

In 1853 and 1854 the right of pre-emption on unsurveyed lands was extended to a number of the States, and afterward, by the Act of 2 June 1862, to all unsurveyed public land.

The passage of the Pre-emption Act and the change in sentiment regarding the public lands rendered less important the early system of disposing of the lands at public sale.

Soon after the passage of the Pre-emption Act the Commissioner of the General Land Office was, by the Act of 3 Aug. 1846, authorized to offer for sale isolated or disconnected tracts which had not previously been offered without the formality and expense of a proclamation by the President, which had previously been required.

In the course of time the practice of disposing of lands at public sale gradually died out, and now such sales take place only for isolated tracts and in certain other exceptional cases.

From 14 Aug. 1854 to 2 June 1862 there was in force a law providing for a modification in the price of lands taken under the pre-emption acts known as the Graduation Act. Its purpose was to reduce the price of public lands to actual settlers and cultivators. The price of all lands which shall have been in the market for 10 years or upward was fixed at $1 per acre; when this period had reached 15 years the price was reduced to 75 cents per acre, and so on, by graduation of 25 cents for each five years till the period had reached 30 years, after which the price was 12½ cents.

The Pre-emption Law remained in force until 3 March 1891, when it was repealed.

The existing system was inaugurated by the enactment of the Homestead Law 20 May 1862. A detailed statement of its history and present status is found in the article HOMESTEAD LAWS.

The Desert Land Law, now in force, was enacted 3 March 1877, and is treated more in detail under the title DESERT LAND LAWS.

The treatment of the arid and semi-arid areas in the West required special attention and some experimenting which is discussed under the title of RECLAMATION LAWS, the principal of these being that known as the «Carey Act,» enacted 18 Aug. 1894, and the Reclamation Act of 17 June 1902.

A considerable area has been granted under the head of «Private land claims, donations,» etc., recognizing claims based upon the laws of the governments formerly in control of the acquired territory and also upon claims based on settlement upon public lands not authorized by specific law. Considerable areas were granted to encourage wagon road, canal and river improvements to State and corporations.

Congress has also granted very large areas to encourage the building of railroads in the Western States, usually granting the odd-numbered sections within a certain distance from the line of road, this distance varying from 6 to 20 miles on either side.

There have also been granted to the States large areas covered by swamp lands on the theory that the State would reclaim them, but comparatively little has been done in this direction.

Congress in disposing of the public lands has been very liberal in grants for educational purposes, providing in each State large areas for the public schools and special grants for State universities. In the acts admitting the several States to the Union until recently two full sections of land in each township were set apart for public schools, being two square miles or 1,280 acres in each township of 36 square miles or one-eighteenth of the area. In recent years the school grant has been doubled, four square miles in each 36, or one-ninth, being set apart for public school purposes. Congress has made other grants to a number of the States for public buildings, internal improvements, etc.

Military and naval land warrants were issued in recognition of service in war, and about 61,000,000 acres of land have been so taken.

Scrip represents a form of authority to take public lands given in adjustment of rights claimed to lands which could not be satisfied by granting the particular lands claimed.

Reservations of various kinds have been made; the largest areas are covered by the National Forests (q.v.). The National Monuments are established to retain for public use lands which have special historic or scenic value.

The history of our public lands and the policy applied to their disposition divides itself into three distinct periods.

The first period is characterized by the desire to dispose of the land in large tracts and to secure as great and rapid a return as possible.

In the second period the desire for return becomes less important and the encouragement of settlement is the main feature.

In the third period the obtaining of funds from the sales of the lands is entirely subordinated and the main desire is to secure the establishment of homes on comparatively small tracts and a utilization of lands available for grazing or mineral or other resources under regulations for the general public benefit.

The table in the beginning of this article shows that the area which has been disposed of and the area reserved for public purposes make a total of about 1,245,636,095 acres. This does not include lands in the original 13 States or Texas, because the United States had no lands in these States available for general disposition. Figures are not available to show the details which make up this total area disposed of by the United States. The principal items are the following, being the areas disposed of to 30 June 1915, as published by the General Land Office, except where followed by the figures (1904), which are the results published in 1905 by the Public Lands Commission appointed by President Roosevelt. The figures of this commission here given have not changed very much to date as they refer to methods of disposition not now in force.

Private land claims, donations, etc.	(1904)	33,400,000
Railroad, wagon road, canal and river improvement grants		122,215,763
Swamp land grants		63,832,583
Common school grants to States, including Alaska		98,400,000
Other grants to States and Alaska		34,900,000
Military and naval land warrants	(1904)	61,000,000
Scrip issued for various purposes	(1904)	9,300,000
Homestead entries		154,327,812
Timber and stone entries		13,289,906
Timber culture entries		10,866,529
Desert land entries		7,210,562
Cash entries, including entries under the Pre-emption and other acts	(1904)	270,000,000
National forests		184,240,596
National monuments		1,201,568
Indian reservations (excluding Alaska)		33,334,261

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PUBLIC LAW. In general public law as contradistinguished from private law, which determines the status and relationships of persons and property, may be defined as that branch of the law which deals with the organization of the state and the relations which subsist between it and the individuals who compose it, as well as its relations to other states. The distinction between public and private law was emphasized by the Roman jurists who taught that *publicum jus est quod ad statum rei Romanæ spectat, privatum quod singulorum utilitatem.* It is equally recognized in the legal systems of continental Europe to-day and finds a place in their classification of the law. In England and the United States, however, while the distinction is recognized by the jurists, its importance has never been emphasized to the same degree.

What are the characteristics of public law and how does it differ from private law? Lord Bacon, who dwelt upon the distinction, said public law was the «sinews of property,» while private law was the «sinews of government.» In private law the state is the arbiter rather than a party; in public law it is both arbiter and a party. Private law determines the rules of conduct to be observed by individuals in their mutual relations; it defines their rights of person and of property; it deals with such matters as the ownership, use and disposition of property, contract, agency, partnership and business generally, the relations between husband and wife, parent and child, guardian and ward and the domestic relations generally, etc. Public law, as stated above, deals with the organization, powers and rights of the state, including its relation to individuals subject to its jurisdiction and to other states. It may be conveniently subdivided into five branches: (1) constitutional law; (2) administrative law; (3) criminal law; (4) criminal procedure, and (5) international law. Constitutional law contains the body of rules, written and unwritten, which determine in broad outline at least the organization of the state. It usually deals with the organization, mode of selection and the powers of the chief organs of government, legislative, executive and judicial. It defines the suffrage, the relations, if any, between church and state, the relations between the state and its local subdivisions, etc. Administrative law is that part of public law which governs the relations of the executive and administrative authorities of the government to one another and to individuals; it defines the organization and determines the competence of the administrative authorities, and sets forth the remedies of the individual in case his rights are violated by the administrative authorities. On the continent of Europe administrative law (*Droit administratif* in France; *Verwaltungsrecht* in Germany) is treated as a distinct branch of the law and is applied by a separate and distinct group of tribunals known as administrative courts composed in part of judges who are professionally trained or who are active administrative experts. In England and the United States, however, administrative law is not classified and treated as a separate branch of the law nor applied by a distinct set of tribunals; but this does not mean that administrative law has no existence in those countries. It only means that no distinction is made between administrative controversies and controversies between private individuals; both alike being determined by the ordinary judicial tribunals and the remedies of the individual being the same whether the issue is between private individuals or between an individual and the government.

The criminal law is usually classified as a branch of public law because it deals with offenses against the state as the guardian of public order and the protector of individual rights. By the law of every country a crime is regarded not as injury to the particular individual who may be the immediate victim but as an offense against the whole society and the state provides the machinery for its punishment. The law, therefore, which prescribes the punishment and organizes the machinery for the enforcement of the criminal law may very properly be regarded as a part of the public law. For the same reason the law which prescribes the rules of procedure by which the courts try offenses against the state is regarded as a branch of the public law.

Finally, international law, or the body of rules, whether conventional or customary, which regulates the conduct of independent states in their relations with one another is treated as a part of public law. See INTERNATIONAL LAW.

The place of public law in the general classification of law and its relation to the other branches of the law may be seen from the following outline:

I. PRIVATE LAW....	Persons. Domestic relations. Property. Contracts. Partnership. Agency, etc.
II. PUBLIC LAW.....	Constitutional law. Administrative law. Criminal law. Criminal procedure. International law.

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PUBLIC LIBRARY AND POPULAR EDUCATION. The Growth of the Democratic Idea in Public Libraries.—Historically, the library has always been an adjunct to education. The temple libraries of the Egyptians and Assyrians, the public libraries of the Romans, the monastery and cathedral libraries and the libraries of the mediæval universities kept the educational purposes of the library consciously in the foreground.

Cassiodorus and Saint Benedict in the 6th century emphasized the spiritual benefit to be received from copying and studying the Holy Scriptures. Alcuin (ca. 735–804) was a librarian and a user of libraries as well as a great teacher. The early universities at Trèves, Constantinople, Bagdad, Cairo, Cordova, to say nothing of later universities, were noted for their libraries no less than their teaching faculties.

Cathedral, monastery and other libraries for the clergy, founded in the early centuries of the Christian era, have persisted to our own time. In September 1537 an «injunction» provided that Bibles should be put at public expense into every parish church in England for the free use of the parishioners. In 1651 Humphrey Chetham bequeathed several collections of books to different parishes to serve as parish libraries. Other similar benefactions led Dr. Thomas Bray, the founder of the Society for the Propagation of the Gospel, to secure the passage by Parliament of «An act for the better preservation of parochial libraries in that part of Great Britain called England.» The idea was not confined to England. Johannes Megapolensis, the first pastor at Albany, had a library of 25 volumes furnished by Patroon Van Rensselaer for pastoral use. The Rev. Thomas Bray in 1697 proposed the purchase of «Lending libraries in all the deaneries of England and parochial libraries for Maryland, Virginia and other of the foreign plantations.» A number of these parochial libraries were sent to Annapolis, Albany, Boston, New York, Philadelphia, Williamsburg and elsewhere. The provincial library at Annapolis, which was sent there in 1697, numbered nearly 1,100 volumes, and was «probably the first free circulating library in the United States.»

Bray at first intended the parochial libraries to be for the use of the clergy. He soon changed their purpose to «lending libraries» open to all, the local collections to be supplemented by the larger provincial libraries. He says: «I hope, though the design seems more immediately directed to the service of the clergy, yet gentlemen, physicians and lawyers will perceive they are not neglected in it . . . And indeed those persons of quality whose eldest sons being commonly brought up to no employment have a great deal of time lying upon their hands, seem to me to be as nearly concerned as any to favor it. For many of these young gentlemen, when removed from the universities . . . residing all their lifetime in countries where they can meet with no books to employ themselves in reading and whereby they may be able to improve the talent they have there gained; they do therefore too commonly become not so conspicuous for their excellent knowledge and morals as will ever be expected from men of rank and station in their country.» Bray here emphasizes the value of the library as a continuation school for the laity as well as its vocational value to the clergy. Nevertheless, broad as his ideas were, they were essentially aristocratic as well became a period almost devoid of any appreciation of the need of universal education and in which literary culture was a class distinction, not a recognized public need. This is doubtless the chief reason why Bray's libraries failed, for the most part, to accomplish what he expected of them, and why most of them became not only inactive but actually extinct.

A more significant movement in the educational purpose of the library was the foundation by Benjamin Franklin in 1731 of the library of the Junto. Both club and library were deliberately planned for the self-improvement of the members. The library, which afterward developed into the Library Company of Philadelphia, was the first of the subscription libraries which under the name of Mechanics', Athenæum or Society libraries, Young Men's Institutes, etc., soon spread throughout the United States and England. Though this was a proprietary library, it was a collection for tradesmen and mechanics as well as for the gentry. Within a few weeks after the first books arrived the directors agreed that the librarian «may permit any civil gentleman to peruse the books of the Library in the Library room.» Franklin's democratic purpose is shown by the reference, in his 'Autobiography' (Chap. V) to this library: «This was the mother of all North American subscription libraries, now so numerous. These libraries have improved the general conversation of the Americans, made the common tradesmen and farmers as intelligent as most gentlemen from other countries, and perhaps have contributed in some degree to the stand so generally made throughout the colonies in defense of their privileges.» Libraries of this type were really more nearly free than their names imply. They were open to practically everyone, their fees were usually small and entirely free use of their reading-rooms was a fairly general practice. Together with the small local «lyceum» libraries which became very common in the fifth to the seventh decade of the 19th century, they did much to promote the reading of American literature and to shape American popular opinion.

Two notable library conferences (in 1853 in New York and 1876 in Philadelphia) greatly stimulated the development of the American public library. Many libraries supported by public tax for public use were already in existence. New York State in 1835 had established a system of «district libraries» in each school district of the State for the free use of the people of the district. Similar legislation was passed in many other States but in few cases was the use of the library at all commensurate with the hopes of the founders. The chief reason was that the library existed, in most cases, as an unadministered collection of books, growing or diminishing by chance and with little or no reference to the tastes or needs of its patrons. The idea that the education of the people through reading should be fostered by State revenues and not left by chance to proprietary or endowed institutions was of slow evolution. Many libraries had long been «public» in the sense of allowing all to use them who wished to do so but there had been little attempt to adapt the character of the library to the need of its community. Thus the Free Library of Hamburg, founded in 1539, issued in 1869 but 4,000 volumes, though its collection numbered nearly 200,000 volumes, chiefly because it was never a really popular library. This is typical of nearly all of the so-called public libraries in Europe and America up to the last quarter of the 19th century.

The new type of public library was described in 1876 by Dr. William F. Poole as follows: "The public library which we are to consider is established by state laws, is supported by local taxation and voluntary gifts, is managed as a public trust, and every citizen of the city or town which maintains it has an equal share in its privileges of reference and circulation. It is not a library simply for scholars and professional men . . . but for the whole community — the mechanic, the laboring man, the serving-girl, the youth and all who desire to read, whatever their rank, intelligence or condition in life. It is the adjunct and supplement of the common-school system. Both are established and maintained on the same principles — that general education is essential to the highest welfare of any people: and considered simply as a question of political economy, it is better and cheaper in the long run to educate a community than to support prisons and reformatories."

Massachusetts in 1847 had authorized Boston to tax itself for a free public library; New Hampshire in 1849 passed a general law enabling towns to establish and maintain libraries by public taxation. William Ewart secured in 1850 the passage of a bill permitting "the establishment of public libraries and museums in all municipal towns, in England." Massachusetts in 1851 passed a general law permitting towns throughout the State to establish and maintain public libraries by public tax. The whole underlying purpose of such libraries is democratic. Everyone has equal opportunity to use the books he needs for culture, recreation or for aid in his daily vocation. As the public school has more generally recognized the duty of fitting the individual student to take an individual part in society instead of merely putting him through a uniform course of general training, the educational value of the library has been more generally recognized. The school library has been developed to meet the need of those still in school. The public library meets the needs both of those still in school and those who have left school. By far the greater part of the people of any country leave school with only a slight amount of formal training. Compulsory education seldom extends beyond the 14th or at most the 16th year. Private libraries, especially in the United States, are not generally increasing in number or value. Individual education on civic problems in whose determination every voter has a part can in most cases be obtained in any adequate degree only through an active, well-selected public library. President Hibben of Princeton University says: "At this time [1916], when the whole world seems rushing on to an unknown future, you [librarians] are holding fast the great articles of the past. You are guarding the sources of knowledge. The library is to-day the only absolutely democratic institution that man possesses." Andrew Carnegie gives as the greatest recent accomplishment of the public library: "The spread of the truth that the public library, free to all the people, gives nothing for nothing; that the reader must himself climb the ladder and in climbing gain knowledge how to live his life well."

Democracy in any country cannot safely content itself with developing a high average of intelligence, essential as this is. Exceptional citizens must be enabled to develop their exceptional abilities, for the service of the whole community. Every public library must aim to collect some material which, though directly used by only a minority of its public, through them serves the whole community. Not only do the larger libraries aid the research student by their own collections, but virtually the whole country can be served through inter-library loans of material valuable only to the exceptional few.

Substantial agreement on the fundamental moral and social ideas whose sum forms the national ideal is essential for the welfare of any self-determining nation. This is the whole purpose of popular education at public expense. One more step is necessary. Present-day society is so rapidly developing new ideals and modifying old ones that constant self-instruction in prevalent current opinion is necessary for good citizenship and, consequently, for national stability. No school course can give this to the adult. The public library, whose duty is to contain books and periodicals on all phases of controverted subjects, is the only institution which can even measurably give this instruction at times and in forms suited to individual needs.

The recent war has shown clearly the importance of *morale* in military affairs and every well-considered scheme for the social readjustments which are following the war has included the development of peace-time *morale*. The library cultivates civic *morale* through its recreational reading as well as through its professedly educational books. Even the business library has this for one of its aims. The good library of this type usually includes recreational books as a welfare project.

Official Connection of Library and Public Education.— Many legal decisions in the United States, England, Canada, Scandinavia and elsewhere have officially recognized the library as an educational institution. It is on this basis that the library chiefly bases its claims to tax exemption and to direct tax support. In virtually every civilized country the control of libraries is vested in the official department which directs public education.

In the United States the connection between the public library and popular education is usually made by the State Library Commission or by making the library activities of the State a duty of the State Education Department (as in New York and Utah).

Since popular education in the United States most nearly follows a democratic ideal, it is natural that the connection of public education and public library is closer than in any other country. Canada (especially in the province of Ontario) and most European countries include both school and library under their ministries of education. In Norway and Denmark there is a general tendency to consider both school and library essential in popular education. England is beginning to show a similar disposition — an example followed in varying degrees by many of her colonies. In Italy, the connection, though theoretically recognized, is not practically realized to any great extent. France and Germany, with their rigid courses of elementary and secondary training, discourage rather than encourage individual research for those below the university and make little attempt to establish or use public libraries for direct educational purposes. Several provinces of India (notably Baroda and the Punjab) have established library systems for the purpose of popular education.

Specific Educational Activities of the Public Library.— The main lines of direct educational activity in vogue in American libraries are noted below. They are characteristic of the work of nearly all of the better public libraries of the country, though the emphasis on different activities will vary in different places. These are also in the main the same as those of other countries in which the public library is recognized as a part of the public educational system.

(a) Work with Schools.— The school library, definitely planned as an auxiliary to the school course, is rapidly assuming a place of its own. Its limited purpose will always more or less limit its independent development. The public library can and usually does supplement the school library in various ways. Instruction in the use of books and libraries is often given in the public library. Books which the school library cannot afford or which it needs only occasionally are purchased by the public library and books and space are reserved in reading-rooms for the use of individual pupils as well as entire classes. Reference lists are compiled for the use of teachers and pupils and the attention of teachers is called to recent material of use in school work. School collections of pamphlets, clippings, maps, pictures and lantern slides are supplemented by loans from the local public library collection. Material is made accessible at the public library at hours when the school library cannot conveniently be kept open. Much of the technical routine of cataloging, classification, book purchase, etc., is frequently done through the public library. In some cases, especially in small places, school and public library unite to employ a competent librarian who serves both. In others, branches of the public library, for general public use, are maintained in public school buildings. This interrelation of the two types of libraries tends to make habitual the use of the library after the pupil has left school. In a rather large number of cases, the public library selects the school librarian and administers the school library subject to the general consent of the school authorities.

(b) Work with Children.— The children's room of the public library also supplements the work of the school. The story-hour and the collection of children's literature enable the child to read voluntarily along the lines of his individual tastes. A wider range of subjects and a greater freedom of treatment than the school can give are usually open to the children's librarian. This is especially important in connection with elementary schools and the tendency of teacher, school librarian and children's librarian to work together in this direction is increasing.

(c) Work with Clubs and Societies.— This work may be either with children or adults. In the former case it is usually conducted by the children's department of the public library either independently or in connection with some distinct organization such as the Boy Scouts, Girl Scouts, etc. Carefully selected collections of books suited to the age and taste of the club members are provided, and in many cases meeting-rooms are provided by the library. Boys' and girls' reading, debating or social clubs are also often organized and conducted by the library. The voluntary character of these clubs and the usual insistence on self-government not only act favorably on the older boys and girls who have left school but react very favorably on those still in school.

The adult clubs whose activities are related to the library vary in character from trade unions and other industrial societies (to whom industrial as well as recreational books are supplied) to classes of aliens learning English and to social clubs with literary or sociological purposes. Suitable books and other printed material are furnished and the library often serves as a clearing-house for the club activities. As a public institution, impartial in its aim to furnish any legitimate information on any question affecting public welfare, the library is pre-eminently suited to be an agent in the demonstration of practicable democracy. Its educational service is especially direct in supplementing the conscious attempt at self-culture which is the usual feature of these clubs.

(d) Lectures and Exhibitions.— Closely allied in purpose with the work of the public library with clubs are the lectures and exhibitions held under its auspices in the auditoriums which are a part of most modern public library buildings. These are often conducted by outside organizations to which the library gives a meeting-place or exhibit-room. In such cases the library usually attempts to develop and conserve the educational results by preparing lists of books, periodicals or prints relating to the subject of the lecture or exhibit or by making prominently accessible the selected resources of the library on the subject. In other cases the library prepares the exhibit or plans and conducts the lecture-course and supplements it by its printed material. Exhibits of local industries, arts and crafts and current and local history have shown rather definite educational results. At present the public library is often the only substitute for the public museum. When the work of the public library and the public museum become more closely related, greater results may be expected.

(e) Civic Education.— The library's contribution to civic education has already been noticed. By supplementing the school course, by providing standard and current material on civic matters, by aiding clubs devoted to the study of social questions and by lecture and exhibit the library is an educational force. It furnishes the impartial publicity which promotes discussion of public affairs and which leads to more intelligent decisions concerning them.

The European War revealed the effectiveness of the library as an agent in educational propaganda. The promoters of the liberty loan campaigns, the allied war service campaigns, the land army and similar movements found it an admirable agent for the effective, economical distribution of their printed material as well as for the display of their posters and other advertising material. It furnished material for speakers and writers for the various campaigns. Its effectiveness in this direction has led it to be used by other agencies for public service. Its use as a clearing-house for public information of all kinds seems destined to increase. Its public usefulness in this direction must obviously depend on the judgment shown by the librarian in deciding what organizations and movements are granted this library privilege and by the extent to which they are permitted or encouraged to use it.

In the broader field of international relations the public library can play a very important part through its selection of material dealing with the life, thought and natural resources of foreign countries and by using them to supplement the agencies for civic education already mentioned. It is already proving of great service to schools with inadequate library facilities on whom the present program of Americanization has been imposed with little opportunity for preparation to carry it out.

In the special field of Americanizing the alien the library has been of very direct service. It has supplemented the efforts of the school and other social organizations. It has often anticipated their methods. To many foreigners the library has been the only public institution standing for equal opportunity for voluntary effort. Its auditorium has often been the only respectable meeting place open without taint of specific social or religious propaganda to the alien social group. It has kept alive the human relations of the alien by giving him books and periodicals in his own language, dealing with the United States as well as with his native land. It has organized classes for the study of English and of American institutions and has freely furnished its books to other instructional agencies. Its service is to individuals, not to nationalities or to classes in the mass. Through the cultivation of individual thinking, — the motive principle of democratic education,— it discourages mob thinking and mob action and maintains the traditional American attitude toward civic rights and duties.

(f) Æsthetic Education.— The growing consciousness of the American public to the importance of the cultural in American life is directly aided by the public library. The importance of the library in cultivating literary taste is generally recognized. Much of the support of its work is based on its success in getting the public to use the best books, from a literary and ethical standpoint, which the individual members of that public can read with profit. Its undoubted influence in the formation of public taste in this direction sometimes obscures its equally direct service in æsthetic education.

Nearly every large public library and many small ones maintain collections of prints and act as distributing centres for lantern slides, motion pictures and other illustrative material either from their own collection or lent by larger or more special libraries or departments of education. (See VISUAL INSTRUCTION). Under present housing conditions the public library is often the only practicable public place for the collection of prints and the larger and more costly illustrated books and monographs on art. Some libraries and education departments lend framed pictures for school and home use. The library art collection promotes local arts and crafts as well as art appreciation in general.

Nearly all public libraries include some books on the history and criticism of music. Collections of musical scores and single compositions, instrumental and vocal, are common. A few libraries maintain collections of music rolls for mechanical piano-players. The high cost and perishable character of talking machine records has so far prevented the establishment of many such collections for public use, but some libraries, notably in California, have formed such collections. Many school libraries have collections of these records selected for their direct educational value. The success of many recent "community sings" has been partly dependent on the music collection of the local library.

In the matter of permanent art exhibits the library is properly subordinate to the public museum. In the absence of the latter and to supplement it, the library exhibits as noted above can have distinct educational value.

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PUBLIC LOAN BANKS. See BANKS AND BANKING — WORLD'S SYSTEMS AND FEDERAL RESERVE SYSTEM; MORRIS PLAN, THE.

PUBLIC PRINTER. See GOVERNMENT PRINTING OFFICE.

PUBLIC RECORDS. See ARCHIVES.

PUBLIC ROAD AND RURAL ENGINEERING, Office of. See AGRICULTURE, DEPARTMENT OF.

PUBLIC SCHOOL ORGANIZATION. This article on school organization deals first with the kind, distribution and relation of schools in the community, second with the organization of the supervisory and teaching force in the system and in the individual school. The ordinary units of school organization are rural districts, townships, villages and cities. By far the most of the rural schools have but one teacher who instructs all the children who attend, dividing them into as many grades as seem desirable. A few rural schools have two teachers and in occasional instances a larger number is employed. The township system usually includes a number of rural schools of one or more departments and a larger centrally located school where academic studies and perhaps industrial and homemaking courses are pursued. The proportions of the total number of pupils in the township registered in the outlying schools and in the central school respectively vary greatly. In some instances few if any outlying schools are maintained and pupils are brought to the central school by carryalls or auto buses. In other cases only the pupils of high school age or those of the upper grades and the high school, are brought to the central school, while the smaller children attend rural schools near their homes.

In order to explain most easily the school organization of communities of varying sizes, the development of a typical school system from village to city will be described. A small village usually maintains either a "graded" school, that is, a school with teachers and pupils sufficient to maintain a full eight-grade organization, or a combined grade school and high school. In this way the term "high school" is sometimes used rather deceptively to denote a school in reality consisting of both high school and grades. As the village grows there are likely to be added outlying grade schools, at first small with the lower grades only, and later with complete grade organization. At about this time the high school is likely to be separated from the grades and placed in a building adapted to its special needs. As the village develops into a large city grade schools multiply and the number of high schools increases. Special high schools for industrial, commercial, homemaking, vocational instruction are added, or these lines of work form recognized departments of the regular high school. Grade schools will be placed as the density of the population demands and high schools will be so located as to serve definite sections of the city. Unless the city develop beyond the half million mark there will probably not be more than one or at most two special high schools such as those just named, and these will be centrally located.

The development of the junior high school, a form of city school organization which at the time of writing is found in but comparatively few American villages and cities, seems likely to bring about within a period of years a general reorganization of school systems. It is sufficient to say here that the junior high school contemplates the division of the 12 years of public school education into three periods, probably with one or the other of the following groupings: 6–3–3, or 6–2–4. There will be an elementary course of six years, a junior high school course of three or two years and a senior high school course of three or four years. This change would necessitate the placing of six-year grade schools as needed, junior high schools as required as centres to which pupils from a number of elementary schools would come, and high schools in turn as centres to which the graduates of a number of junior high schools would come.

The chief administrative officer of a small school is the principal who has charge, under the direction of the local school trustee or trustees and usually of the county or State school authorities, of the organization and instruction throughout the school. In small schools the principal gives much of his time to classroom instruction, but as the schools grow larger less time is given to instruction and more to supervision. Many principals in village high schools and nearly all principals of large village or city grade schools give all or essentially all of their time to supervisory duties. Although there is naturally much variation in this respect, it is seldom that a principal teaches more than a few hours weekly if he has the supervision of 15 to 20 teachers.

In larger communities the chief school administrative officer is the superintendent. In different parts of the country the term has very different significance as to size of the community and the number of teachers supervised. Usually in a community having a superintendent there are more school buildings than one and the superintendent is not a part of the organization in any one building, but maintains an office frequently outside of the school buildings and has the same supervisory relation to all of them. In its simplest form a typical school system organized under a superintendent consists of the superintendent, two or more grade principals with separate teaching staffs, and ordinarily a high school principal and teaching force. This organization is subject to many possible variations. As has been said elsewhere in this article, development is along the line of additional groups of grade school, high school and technical school teachers, each group having its principal. In large city systems assistant superintendents, supervisors of instruction in the various subjects and officials charged with the care of buildings, records, finances, etc., are added.

Within the individual school there may or may not be further organization. This is largely dependent upon the size of the school. When the number of teachers in the grade school becomes too large for the principal to supervise effectively he is usually assisted by one or more of the following department principals: primary, grades one to three, intermediate, grades four to six, grammar, grades seven and eight, or by an assistant principal with general duties. The high school principal in a school large enough to have about three or more teachers of each subject, i.e., of English, mathematics, etc., is assisted by heads or chairmen of departments, through whose hands goes more or less of the administrative work regarding the organization of classes and supervision of instruction in the respective subjects. In large city high schools assistant principals are frequently provided.

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PUBLIC SCHOOLS. The idea of a free public school maintained entirely at municipal or State expense and altogether under State and secular control is a modern development, which was not realized until the 19th century. The growth of democracy in the last 100 years has been one of the chief causes of the rapid advance of the free and secularized public school system. Only in the United States, however, has the public school system had a development such as a democratic society logically demands.

A system to be truly democratic must have the following characteristics: (1) It must be free to all; (2) it must extend over all stages of education; (3) it must have what is called the «educational ladder»; that is, pupils must be able to pass upward freely from one grade to the next higher; and (4) it must be patronized by all classes of the community.

It may fairly be claimed that the American public school system has now reached a stage where all these ends have been attained. In Germany, France and until recently, at least, in England, public education has not been, and is not even now, generally free, since, though most of the expenses have been met from public or institutional (usually religious) sources, each pupil unless a pauper has had to pay school fees. No educational ladder exists in those countries, for secondary education begins at eight or 10 years of age and always in schools parallel to the elementary schools. The pupil who completes the public school at the age of 14 must go back from four to six years if he wants to have a secondary education. In the United States, however, the pupil enters the high school without loss of time, since the high school begins where the elementary school ends. It naturally follows that in European countries only the children of the «lower classes» attend the elementary schools, and that it is only in exceptional cases that they ever find their way into schools of secondary and higher education. From the beginning, in those countries, the secondary schools, and later the universities, are patronized by the higher social classes, reinforced to some extent by the children of thrifty and ambitious members of the lower ones. In sharp contrast to this state of affairs, it is the proud boast of the American school system at its best that the public school is open to the poorest and is good enough for the highest; that in form, at least, the system is so organized that the road is open for every child in the republic to carry his mental development to the highest possible point; for not only are elementary and secondary schools free and properly articulated, but in most of the States a free education is offered also in universities. It is furthermore a matter of daily observation that all classes of our population freely patronize the public schools. The only considerable exception is the private religious, or parochial, school, where the motive for segregation is religious, not social. Nearly 90 per cent of all children of elementary grade attend the public school.

Colonial Beginnings of Public School Evolution.—The beginnings of the free common school reach back to the earliest colonial times. In New England, at least, the predominant motive for promoting public education was religious rather than political. The elementary school of that period quickly merged into the academy or secondary school, where the promising lads were prepared for college. However, the idea that the early education should be free, and in considerable degree compulsory upon all, found early expression. The General Court of Massachusetts in 1642 enjoined upon town authorities the duty of seeing that all children acquired at least the rudiments of an education. The order even went so far as to require the removal of children from those parents who persisted in bringing up their offspring in ignorance. The selectmen of every town were further required «to have a vigilant eye over their brethren and neighbors, to see that none of them shall suffer so much barbarism in any of their families, as not to endeavor to teach, by themselves or others, their children and apprentices, so much learning as may enable them perfectly to read the English tongue and (obtain) a knowledge of the capital laws; upon penalty of 20 shillings for each neglect therein.» In 1635 Boston made public provision for the support of a school. The Act of 1642 was greatly strengthened by the Massachusetts School Law of 1647, which required all towns having 50 householders to «appoint one within their town to teach all such children as shall report to him, to write and read; whose wages shall be paid, either by the parents or masters of such children, or by the inhabitants in general,» and which further required that where any town has increased to 100 families or householders, «they shall set up a grammar school, the master thereof being able to instruct youths so far as they may be fitted for the university.» This law laid the foundations for the present free elementary and the free secondary, or high school, for though it did not insist that all school revenues should be raised by public taxation, it provided that they *might* be so raised, and it made the community responsible for the establishment and maintenance of schools for all its children. In 1638 New Haven set up a school under Ezekiel Cheever, who was paid «out of the common stock of the town.» Rhode Island established a public school at Newport in 1640, and Providence one 20 years later. In 1633 the first Dutch schoolmaster arrived at Manhattan, when the first school tax, amounting to £4, was levied and collected. By 1650 the 800 inhabitants of New Amsterdam paid their schoolmasters regularly from the public treasury.

More or less rudimentary beginnings of public education are found in the older colonies, as in New Jersey, Pennsylvania, Virginia and the Carolinas. In the South, however, the free school idea was not so hospitably received as in New England and in New York. An oft-quoted expression by Governor Berkeley of Virginia may be cited. When the English Commissioners of Foreign Plantations asked what course was taken in Virginia for instructing the people in the Christian religion, Governor Berkeley replied, «The same that is taken in England out of towns, every man, according to his ability instructing his children.» He also added, «I thank God there are no free schools nor printing presses, and I hope we shall not have them these hundred years; for learning has brought disobedience and heresy, and sects into the world, and printing has divulged them and libels against the best of governments:

God keep us from both!» So far as Virginia and the remainder of the South were concerned, good Governor Berkeley had his wish, for it was not until after the Civil War that that section of the United States was supplied with anything like a system of free public schools.

The Revolutionary Period.— In all European countries at this period, the financial responsibility for the education of children was held to belong to the parents, so that neither state nor community, religious or charitable organization, ever desired to make education free, except for children of paupers or others unable to meet the expense. The idea that free schools are only for paupers or the very poor permeated most of the American colonies during the Revolutionary period of American education. Even where the schools were not strictly private, the «rate-bill» for all who could pay was a common device for helping to meet the expenses of the school. This idea prevailed in Pennsylvania, Rhode Island, New York, New Jersey and the South. Some States raised taxes to school the paupers, but they made those pay who could do so. Only in Massachusetts and in the more democratic settlements west of the Alleghany Mountains did the pauper idea of free schools fail to obtain a firm hold upon the people. The fees were collected in various forms. In cities the assessment was usually in money; in country districts both East and West the rate frequently included a period of board for the teacher, who was thus obliged to «board round» among the families of his district. By 1848 all fees were abolished in Rhode Island. They lasted until 1864 in Vermont, 1867 in New York, 1868 in Connecticut and until 1871 in New Jersey.

Development of State Control.— From the earliest times in America the responsibility for the support of schools was focused upon the settlement, village or town, never upon the colony, or later upon the State as a political entity. This condition of things lasted well into the first quarter of the 19th century. Since that time, however, there has been a steady advance toward State support, supervision and control of public elementary education. In no State of the American Union has the right to control the public schools been abruptly assumed by State authority; on the contrary, State control has sprung almost spontaneously from natural conditions, chief among which have been the rapid growth of population and the equally rapid growth of State school funds. The process has been somewhat as follows: As soon as a given State, say Illinois, had at its disposal a considerable amount of money for annual distribution among the school districts, it was natural that the legislature should lay down the conditions with which the district must comply in order to enjoy such aid. Among the first things prescribed would naturally be (1) a minimum number of days during which the school must be held in session; (2) a course of study that must be taught; (3) the certification of teachers, usually be county authority, but in subjects prescribed by the State. Again, individual communities, however loath to relinquish the management of their own school affairs in their own way, have been obliged to bow to the will of the State, in so far as it saw fit to assert its authority since the power to levy and collect taxes is derived directly from the State. At present all State constitutions contain provisions relating to popular education.

The idea that has everywhere prevailed is that the State should in every way possible stimulate local interest and local effort for the support and improvement of schools, laying its hand of authority only upon those general essentials of the school system which are indispensable to efficiency. This is why the American public school system has manifested such astonishing elasticity. Every community can have as good or as poor schools (down to a certain point) as it desires. The salaries may be high or low, the equipment ample or inadequate, the schools backward or progressive as the community wills. Again, this elasticity is felt also within the teaching body, quite aside from the general tone of the community. It is not uncommon to find public sentiment quickened and elevated by a corps of teachers led by an active and progressive superintendent. The absence of restrictive State control as to subject matter, methods of teaching and school organization opens the door to individual initiative, and to consequent progress. The interaction of the two influences, that of the State on the one hand, with its general prescriptions and supervision, and that of the local community, on the other, with its power of adjustment to circumstances, makes the American school system the most perfect adaptation to democratic needs that is to be found in the world. Any civilized European system maintains standards with respect to given particulars that the American public school as a whole can by no means measure up to; but it may be confidently asserted that no European system, however excellent, could, if put into operation in an American State, produce results so wholesome and excellent as those that come from the present system.

The Growth of Public School Funds.— Individual States began at a very early period to establish permanent funds for the support of common schools. In 1795 the lands known as the «Western Reserve,» held by Connecticut, were sold for $1,000,000, and the money turned into the school fund. New York also made provision for common schools by setting aside a portion of the public lands for this purpose. New Hampshire began a school fund by exacting one-half of 1 per cent upon the capital of banks within the State. Other States made similar but less effective efforts, a favorite means being the granting of lottery privileges for the raising of funds. Much more fruitful sources of permanent school funds in the several States have been Congressional land grants that have been made from time to time out of the unsettled government land lying to the west of the original colonies. Each of the States subsequently carved from this vast territory received a grant varying from one to three sections from each township for school purposes. In addition to the direct appropriation of land, it has been the policy of the government to turn into the State treasuries, also, a percentage of the net proceeds from the sale of public lands within their borders. In some States, the school lands were sold at an early date at low prices; in others the lands are held to the present day. By act of Congress 1836 a surplus in the United States treasury was distributed among the States. The amount actually given was something less than $30,000,000. In 16 of the 26 States then existing, this money was appropriated in whole or in part to the permanent schools' funds. The present total annual income from permanent school funds and the rent of school lands is something over $17,500,000, but this amount is very unevenly distributed among the States. When we consider that the total annual expenditure for public schools now closely approximates $640,000,000, it can be seen that the income from permanent funds forms but a small fraction of what is actully expended; yet it would be an error to assume that the influence of these public funds has been limited to their comparative magnitude.

Systems of Administration.— Developing as the public school has done from the individual settlement as the starting point, it can easily be understood why the district system of administration has been so potent in the past, and why in some States the people still cling so persistently to this form of management. The «school district,» our oldest and most primary form of school organization, is the smallest civil division of our political system. It was early recognized by law and given legal functions and responsibilities. The district manages its school affairs in a simple way, a board of directors or trustees, usually three in number, being elected to employ the teacher, determine the amount of money to be expended and in general to conduct the school affairs of the district. This is the most elementary and at the same time the most democratic of methods for school administration. It is particularly well fitted to sparsely settled sections of country, but not so well adapted to denser populations, since it prevents the efficiency that arises from consolidation.

The township system forms the next natural stage in the development of school administration, since it is based on a convenient political unit, not too large for effective local direction. In this system, one set of officers conducts the educational affairs of the whole township, erecting buildings where they will best accommodate the people, employing teachers, grading the schools, in many cases providing for the transportation of children to and from school, and usually crowning the whole with a township high school, to which pupils may be promoted upon the completion of their elementary course. The State of Indiana has been a pioneer in introducing the township system. A number of other States have adopted it wholly or in part.

Most if not all the Southern States have a county system of school administration, because there the county rather than the township is the unit of government. While in the Northern States the county has never been the unit for civil or for educational organization, it is and has long been the unit for supervision of schools. With but few exceptions each county has a superintendent whose chief duties are: (1) the certification of teachers; (2) the personal supervision of the schools through visitation; (3) the conducting of teachers' institutes.

The foregoing organization exists chiefly for the administration of rural and village schools. Nothing has been more marked than the development of cities. It is obvious that administration through the primitive district system would soon become altogether inadequate for the needs of a city. Legislatures have accordingly made special laws to meet the needs of cities of various classes. The largest cities in a State, like New York City, Buffalo and Rochester, in New York, usually have special charters enabling them to conduct their schools as they deem best. Cities as a rule have boards of education for the administration of the system. These boards differ greatly in size and in the manner of their appointment. In most cities the members are elected by the people for stated periods, sometimes at large, sometimes by wards or subdistricts. In some of the larger cities the members are appointed by the mayor and city council acting jointly.

Housing and Equipment.—Nothing is more noteworthy than the development of public school architecture in the United States. In full accord with its democratic genesis, the housing and equipment reflects completely the educational status of the community. The rural school may be a mere unsightly box with the most primitive apparatus; or it may be an artistic building, adequate in size, well heated, lighted and ventilated, supplied with separate wardrobes for boys and girls, and equipped with needed books and apparatus. State and county superintendents have done much to inform their respective rural communities of what is desirable and practicable in country schoolhouses, furnishing freely plans and specifications, and even providing the builders with complete models for their guidance. In the State of Missouri over 600 rural schoolhouses were erected in a short time in accordance with a model furnished by the State superintendent of public instruction. The cost of a building of this type was $600.

The elementary school covering a period of eight years, the most common type of graded-school building in towns and small cities, is the eight-room schoolhouse — one room for each grade. The heating, ventilation and lighting of such a building has become an important problem. This problem is rendered much more complex in cities where the plan must be enlarged to accommodate from 1,000 to 4,000 pupils. A typical classroom in such a building should be approximately 24 by 32 feet in dimensions, and from 13 to 14 feet in height; it should be lighted entirely from one of its longer sides, the windows reaching to the ceilings; about 2,000 cubic feet of pure warm air per hour should be provided for each pupil; and each room should be provided with a convenient wardrobe. By the use of steam indirect heating, supplemented by «plenum» and «exhaust» fans run by steam or electric power, it has been found practicable to meet the foregoing conditions of heating and ventilating. Practically all of the modern city school buildings secure these most desirable ends. The buildings are usually an architectural ornament to the neighborhood in which they stand. It has gradually come about, therefore, that the public school is one of the best-housed institutions of modern society. In the poorer districts of large cities, the school buildings are the palaces of the people; they are, moreover, the places where the children of the slums find warmth, light, pure air, beauty, and sympathetic humane treatment from their teachers. It is here that their hearts are warmed, their minds developed and supplied with useful and inspiring knowledge; it is here that they are enabled to rise to higher planes of living, and to prepare themselves for a worthier citizenship than their humble origin would seem to warrant. In well-to-do districts of the city, the same beneficent physical surroundings contribute more than any other instrumentality of society to develop the best that there is in democracy.

The Sex of the Teaching Force.— For the first time in history, society has, since the beginning of the 19th century, undertaken to educate all its children, boys and girls alike. Before that time only certain classes of boys were educated, invariably by men teachers. With the new duty there appeared a new means, namely, the employment of women as teachers. So long as women remained uneducated, it occurred to no one, least of all the women themselves, that they could teach. So long as they could find productive labor in the home, as they could until steam-power and machinery drove industries to the factory, women felt no especial need of a new calling. But when remunerative labor for women failed in the home, when the schools began to educate them along with their brothers, and when the new social undertaking of universal education began to clamor for more and cheaper teachers, then it was that the world awoke to the fact that it had in its midst a new and hitherto unused force — its young unmarried women. Women began to be employed as teachers in large numbers in the United States before 1850, especially in the New England States, where the first normal schools were established. The period of the Civil War saw a rapid increase, owing to the natural withdrawal of the young men in order to enlist as soldiers. Since the close of the war the percentage of women in the schoolroom has steadily and rapidly increased, throughout the Union, until in the cities, at least, men are rarely found as teachers in the grades. They are still employed to some extent in rural schools, especially in the newer States. The following table shows the increase in the number of women teachers in 13 typical States since 1875:

STATES	1875	1880	1886	1902	1916
Vermont	85	83	88	82	92
Pennsylvania	50	52	83	87	78
New Jersey	71	76	79	87	95
Iowa	63	67	76	86	89
Indiana	42	48	49	55	68
Illinois	57	61	67	75	81
Rhode Island	80	78	87	91	92
Missouri	39	43	40	66	75
Connecticut	76	76	82	91	93
Massachusetts	88	87	89	91	89
New Hampshire	86	83	88	91	92
Ohio	46	52	56	62	75
Maine	69	67	65	86	88

The women now number 80.2 per cent of all the teachers in public elementary schools of the whole Union, while in city elementary schools they rarely number less than 90 per cent of all teachers. In New York State high schools about two-thirds of the teachers are women. The same phenomenon is seen in foreign countries, but the increase in the number of women teachers there has in general been less rapid. In Great Britain and Ireland the increase has been from 54.3 per cent in 1870 to 75.3 per cent in 1900. If one may judge by the attendance at the normal schools, the number of men and women in French elementary schools is about equal. In Germany, as a whole, less than 20 per cent of all elementary teachers are women. In Italy, however, 93 per cent of the students of normal schools are young women, though the women form only about 58 per cent of the whole elementary teaching force. In the 11 State normal schools of Massachusetts there are 308 men and 2,811, or 90 per cent, women students.

The large, almost exclusive, employment of women as elementary teachers is the newest thing in our civilization. It is difficult as yet to interpret its full significance. There is no doubt that society has been well served at very small expense. The economic motive constantly appealing to communities that do not like high taxes is that they can get better teaching from women for a small sum than they can from men. A first-class woman teacher, they say, is always to be preferred to a second-rate man at the same salary. The assumption is that vigorous, active, well-prepared men can do better financially out of than in the school, and that only second-rate men will accept women's salaries. Ultimately, if the feminization of the school should prove not to be for the best welfare of society, it is pretty evident that the additional cost will not prevent the employment of a suitable number of men. The public school system may be said to be now in its «brick and mortar» stage, for it is expending vast sums to house and equip the school. When this has been done, the resources of the community may easily be turned to the improvement of the teaching force. Ex-President Eliot of Harvard University argues that the people ought not to spend less upon the minds of their children than they do upon their food. Were this standard attained, it is probable that school support would be quadrupled. So far as present experience teaches, it seems evident that for the first four or five years of school life women are the natural and the more efficient teachers. When it comes to the early years of puberty, society still holds theoretically that the influence of men is essential to the proper unfolding of the minds and characters of both boys and girls. It is this conviction which, for the most part, enables the non-sectarian private school to maintain its existence in the more wealthy communities. It is probable, notwithstanding the aforementioned theory that men are indispensable as teachers of youth, that the availability of women and the difficulty of holding the right type of men in such positions will confirm the present custom of almost exclusively employing women for grade teaching.

The Development of the Public School Curriculum.— Down to 1837, when Massachusetts created her board of education and placed Horace Mann at its head, the curriculum of schools not fitting boys for college was limited to the bare acquisition of the school arts, spelling, reading, writing, ciphering, relieved by a trifle of geography and history. The discipline was always rigid and sometimes harsh; the school term was short and the years of schooling few; the path of learning was not strewn with roses; but the intellectual, like the moral, discipline did honor to the straitest notions of our Puritan forefathers. In his seventh annual report, Mr. Mann, who had visited schools abroad. especially in Germany, where the new philosophy of Pestalozzi was earnestly applied, attacked with great vigor the old curriculum, the old Puritanic ideas and the old unsympathetic methods of teaching. He demanded new subjects more suitable to children, more humane and sympathetic treatment of pupils and new ideals of the ends to be attained by education. These criticisms and demands led to a spirited battle between Mr. Mann and his admirers and the «Thirty-one Boston Schoolmasters,» who defended the old-time rigorism in study and discipline. The result was a drawn battle. The reformers succeeded in getting their ideals and watchwords accepted, but the conservatives preserved the old curriculum practically unchanged. It was, however, a great advance to have the new ideals of character-forming accepted as a supreme end of education. Even if this school were to be confined to the acquisition of the school arts, it was a vast improvement to have the new methods everywhere put into practice, for now the concrete was made to precede the abstract, facts came before principles and inductive reasoning enlivened and enlightened the old-time memory drills and mechanical application of rules. The school term was gradually lengthened and with this there came a perceptible thought-enrichment of the studies by means of which the children were drilled in the use of the tools of knowledge.

This condition of things lasted until after the period of the Civil War, when the rapid development of the public high school, the still more remarkable expansion of the university curriculum and the rise of all sorts of social organizations for the moral and economic welfare of the community, forced upon the public school an amount of new subject matter that is little short of astounding. As already explained, the old curriculum was mostly confined to the studies through which the child was drilled in the use of the school arts. The children learned to read, but they never read anything; they learned to spell and write and parse, but they produced nothing more than an occasional school essay. But now behold how this old course of study has been «enriched!»—(1) by copious amounts of literature suitable to every grade, not only in the elementary but in the high school as well; (2) by systematic «language lessons» throughout the full course; (3) by the occasional introduction of elementary algebra and concrete geometry in the seventh and eighth grades; (4) by four years of history and as many of geography; (5) by nature work in all the grades; (6) by a course in manual training or «occupations» throughout the whole elementary period; (7) by extensive acquisition in fine arts, such as drawing, painting, molding and music, and finally (8) by an obligatory course in physiology and hygiene, accompanied by what is called scientific temperance instruction.

The foregoing may be called reform by addition. Heretofore the method of relief from a congested curriculum has been by subtraction. When the «reform» forces of a community have been in the ascendency, the new subjects have been added; when, on account of complaints of taxpayers, parents and children, the wave of reform has receded, the new subjects, then called «fads,» are dropped and the curriculum assumes something of its old-time proportions. Obviously some method better than that ot addition and subtraction is needed for overcoming this obtrusive dualism in the course of study. That of organization has been suggested by Prof. John Dewey, whereby the school arts shall be made to emerge from the acquisition of extensive bodies of life-giving knowledge. To effect this reform, however, teachers must be better trained, school facilities must be increased and, most important of all, teachers must have smaller classes. The ideal public school of the future will not require one teacher to teach more than 20 children. Now the number often rises to 60.

For statistics of the public school, see EDUCATION, ELEMENTARY.

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PUBLIC UTILITIES. Definition.— Public utility is a term which is not easy to define with precision. When used in a popular sense it applies to those services rendered to the public which are so intimately related to the welfare of the entire community that those who render them are subjected to varying degrees of public control, assume special obligations and duties to the public and enjoy special privileges. A public utility is commonly referred to as a «business affected with a public interest,» and one of its most obvious distinguishing characteristics lies in the fact that those in control must serve equally all who demand its services instead of remaining free, as the ordinary business man is free, to refuse its services to those for whose patronage it does not care. Because of the many legal problems relating to public utilities it might be expected that a satisfactory definition of the term would be found in the literature of the law. We find, however, that lawyers and judges instead of developing an abstract definition have resorted to the familiar practice of marking out the meaning of the term by the process of judicial inclusion and exclusion, i.e., by determining in each concrete case whether or not the business in question is a public utility. By this method it has been established in some or all of our States that the following are public utilities: common carriers of all kinds by land or water, water supply, gas, electricity, telegraphs, telephones, bridges, warehouses, grist-mills, saw-mills, sewers, cemeteries, hospitals, grain elevators, stockyards, cotton gins, docks, hotels, ice plants, markets and news service.

Distinguishing Characteristics.—An examination of the nature of the businesses just mentioned will reveal the fact that there is no single characteristic common to all except the general fact that each of them has the somewhat vague property of being "affected with a public interest." There is no universal distinguishing feature of a public utility. It is possible, however, to point out certain characteristics, one or more of which will be found to mark every public utility. (1) Public utilities frequently enjoy *special legal privileges* denied to other kinds of business enterprises. The right of eminent domain is commonly delegated by the State to corporations for the purpose of constructing railways, pipe lines, irrigation ditches or of erecting poles and wires. Subsidies in money have sometimes been given to various public utilities on the theory that enterprises so vitally necessary to the public welfare might properly be supported or aided from the public funds. This has usually occurred in cases in which it seemed unlikely that sufficient private capital could be relied upon to initiate the enterprise and was a common practice during the early and highly speculative period of railroad development. Grist-mills, saw-mills and drainage and irrigation projects have also received aid from the public treasury from time to time. A third legal privilege is the right to use the public highways in special ways. Concessions of this kind must be secured by public service companies whose businesses require the laying of tracks, the embedding of pipes or wire conduits or the erection of poles and wires. (2) *Legal monopoly* is an attribute sometimes distinguishing public utilities. There are many early examples of exclusive franchise grants made either as special inducements to the investment of capital or as a means of forestalling competition in fields where it would be impracticable or inconvenient. Legal monopolies are now generally regarded as contrary to public policy except in the case of those public utilities which are at the same time either natural or virtual monopolies. (3) Many public utilities are *natural monopolies.* The several factors which may make a business a natural monopoly are outlined by Mr. Bruce Wyman, perhaps the leading authority in this field. First, there may be a limitation upon the source of supply of the commodity or service. This may be the case with the water used for supplying the wants of a city or for irrigation. It is not infrequently true of natural gas and water power. The only available supplies of commodities or services of vital interest to the entire community cannot be regarded merely in the light of private property. They become of necessity public utilities. Second, a natural monopoly may result from a scarcity of advantageous sites upon which to carry on forms of business in which the community as a whole has a paramount interest. This is true of docks, wharves, freight sheds, warehouses of certain kinds, stockyards and grain elevators. Those who occupy the ground first enjoy the advantages of monopoly simply because there is no room physically for a competitor. A third basis for a natural monopoly may be the limitation of time incident to the service rendered. The service is not only necessary but it is immediately necessary. The person who desires it cannot wait. He is not in a position to haggle over price or quality nor to hunt for a possible competitor. This sort of monopoly may be temporary but it is none the less effective. It is this position of vantage which is enjoyed by the hotel keeper, the hackman, the commercial messenger and the telegraph company. In the fourth place the difficulty of distribution of services constitutes in some cases effective limits upon competition and creates a natural monopoly. Fuel in the form of wood or coal may usually be brought to the consumer with an ease which encourages competition. Fuel in form of gas can be brought only through pipes and competition is for all practical purposes precluded. Those who furnish electric light or power, steam heat, water and the like enjoy what is in effect a natural monopoly based upon this difficulty of distribution. (4) Another characteristic of certain public utilities is their enjoyment of what may be called a virtual monopoly, a monopoly which arises not from any of the causes which produce natural monopolies but rather from certain economic restrictions. In the first place, there are many public utilities which represent a capital investment of many millions of dollars. The financial obstacles in the way of competition are sufficient to preclude it. This is apt to be the case with the various transportation facilities, railroads, bridges, terminals, tunnels, pipe lines, ferries and the like. Every business instinct warns the capitalist not to undertake to duplicate the costly equipment already engaged in these enterprises, for the hope of dividing with a competitor a volume of business frequently no greater than can be readily handled by one system. In the second place, virtual monopolies are created by the desirability or even necessity of service on a scale too large to duplicate. The value of the service rendered by a telegraph, telephone or express company depends in large part upon the number of persons, towns or places that are brought into touch with each other through one system. By reason of this fact they are practically sure to be free from competition when once well established. It was because of the virtual monopoly due to the size and complexity of its service that the Associated Press was held to be a public utility.

Obligations Resting upon Public Utilities. — Because the interests of the entire community are directly concerned in the manner in which a public utility is operated and because the public service company is almost invariably the recipient of some of the legal privileges already mentioned, it is necessary and natural that obligations and duties should be imposed on those who engage in public utility enterprises which do not rest upon the ordinary business man conducting an ordinary business. These obligations and duties may be set forth under the following heads: (1) The public utility must serve all who apply. The man who runs a dry-goods store or a carpenter shop may decline the patronage of persons with whom he does not care to deal. His reasons may be entirely arbitrary, but he is nevertheless within his rights. Not so with the public utility corporation. The nature of its business makes necessary a very different rule. The law imposes upon it the obligation of serving any member of the public without discrimination. The railroad company or the hotel cannot arbitrarily pick and choose their patrons. Refusal to serve any one who is entitled to demand its service not only subjects the public utility management to an action for damages but also will lead to the issuance by the courts of a writ of mandamus compelling it to perform the duty of rendering equal service to all. This rule is, however, subject to certain reasonable qualifications. A public utility, for example, may be under a duty to serve only the members of a certain class. Thus common carriers and hotels are obliged to serve only travelers and not those who wish to use their facilities for other purposes. Also there is a duty to serve only those who comply with such reasonable regulations as may be made by the public utility management in the interests of the convenience, health and safety of the public. (2) The public service company must not only serve all who apply but it must give them equal service without discrimination. This does not mean actual identity of service nor does it preclude the establishment of proper systems of priorities, as in the case of emergencies of various kinds or in the transportation of perishable freight. But every member of the public must have the same chance to enjoy these special services. The requirement of equal service does not prevent the segregation of the races by the establishment of so-called "Jim Crow" facilities on common carriers and the like. In such cases, however, the accommodations afforded, though not the same, must in the eye of the law be equal. (3) The public utility must make the same charges to all for the same service. Discriminations and rebates are forbidden. This problem will be considered more fully at a later point. (4) The duty of furnishing adequate service and suitable facilities rests upon those who engage in public utility enterprises. The private business man is free to give poor service or sell inferior goods. Those whose businesses are affected with a public interest must meet the reasonable standards of efficiency or quality set forth usually by corporate charter, franchise or statute. Water, gas and electricity must be supplied continuously and in stipulated quantities and railway coaches must be heated and kept clean. (5) Finally, public utility corporations are subjected to special rules of liability for loss or injury to their patrons in certain cases. In this regard innkeepers and common carriers are in a peculiar position. They are held to have insured the safety of the goods or belongings of their patrons. They are liable for the loss of such property while in their possession, even without fault upon their part. This is a rule of unusual strictness and it does not apply to other kinds of public utilities nor does any such absolute liability attach to common carriers or hotel-keepers for injuries to the persons of their patrons. In fact apart from these special cases the duty which rests upon public service corporations to exercise due care in behalf of the safety of others is in no way peculiar. If the service rendered involves special danger of course special diligence is necessary to constitute reasonable care, but the law requires only the care which a reasonable man under like circumstances would exert. Public service companies, however, are not permitted to enter into contracts by which they exempt themselves from all liability for loss or injury due to their negligence. Such contracts are regarded as contrary to public policy since they would tend to lower the standards of service rendered to the public. It is, however, within limits permissible to make contracts limiting the amount of damages recoverable for losses or to require patrons to place a valuation which shall be regarded as final upon goods transported by a common carrier.

Rights of Public Utilities.— The special obligations resting upon public service corporations are compensated not only by the special legal privileges already referred to but also by certain well-defined legal rights. (1) First, there is the right to reasonable compensation for the service rendered. There is no duty to furnish free service. This right may be enforced by placing a lien upon the property or belongings of the patron. It is also permissible for the public service company to ensure payment by requiring it in advance. (2) In the second place, there is the right to make reasonable rules and regulations regarding the conduct of its business. The non-compliance with these rules by any person is sufficient justification for denying him the service to which he would otherwise be entitled. Such rules are those requiring decent and orderly deportment in inns or public conveyances. Or the rules may bear upon the liability of the management of the public utility for losses suffered by patrons, such as the familiar rule restricting the legal responsibility of hotels to the loss of property placed in checkrooms provided for that purpose.

The Need for Regulation of Public Utilities.— From the foregoing discussion it is obvious that the welfare of the public is vitally concerned with the manner in which the business of a public utility is carried on. Public convenience and economic necessity may demand that public service companies enjoy monopolistic privileges; but it is certainly imperative that any such monopoly be subjected to strict regulation in the public interest. Wherever a business is endowed with privileges and rights not commonly enjoyed, such a business must be held rigidly accountable for the way in which those advantages are used. As public utilities have increased in number and variety, as modern society with the increasing complexity and insistence of its demands has become more vitally dependent upon the services they render and as it has grown ever more apparent that, left to their own devices, public service corporations will usually serve their own interests at the expense of those of the public, the necessity of subjecting them to adequate and scientific regulation has come to be universally recognized. Public utility regulations may be conveniently grouped under three heads: first, regulation of rates or charges; second, regulations to secure equality of service; third, special requirements in the interest of public convenience. Each of these forms of regulations may be briefly discussed.

Regulation of Rates.— Practically every public utility is subjected to regulation in the matter of rates. When a business is affected with a public interest either by reason of its monopolistic character or its enjoyment of peculiar legal privileges, the public must be protected from exploitation through the charging of exorbitant rates. Otherwise public utilities would speedily become agencies of oppression instead of public service.

The question who is to determine what rates shall be charged for public utility services has been answered differently at different times. At the outset the view was taken that the legislature should decide what the rate should be and that public service corporations who felt that the rate so fixed was unreasonably low had no remedy except to persuade the legislature to change its mind. This was the view adopted by the Supreme Court of the United States in the famous case of Munn v. Illinois (94 U. S. 113), decided in 1876, sustaining the right of the legislature of Illinois to fix the charges made by grain elevators. This doctrine has been modified, however, in such a way as to subject the reasonableness of rates fixed either by direct action of the legislature or by commissions acting under its authority to scrutiny by the courts. The courts will not themselves determine what the rate should be as a rule of future policy but confine themselves to the task of approving or invalidating the rates established by legislative authority when the reasonableness of such rates is questioned by litigation.

Needless to say a public utility corporation cannot be deprived of the right to charge a reasonable rate for its services. To deprive it of this right would be to discriminate arbitrarily against it and thereby deny to it the equal protection of the laws. It would also amount to a deprivation of property without due process of law. But to decide in a given case what is a «reasonable» rate is not so simple. The solution of the problem is not much furthered by quoting the rule which our courts have frequently announced that a reasonable rate is one which ensures a «fair return upon a fair valuation of the property devoted to the public use.» This statement, of course, means nothing until some definiteness attaches to the meaning of the terms «fair return» and «fair valuation.» The inability of economists, legislators and judges to agree upon what these terms mean has brought the whole problem of the regulation of public utility rates into a confusion from which it has but very recently begun to emerge.

It is not perhaps so difficult to say what is meant by «fair return,» although it is naturally impossible to lay down as a general rule that it is this or that percentage of profit on a given investment. The courts have reached with practical unanimity the conclusion that a fair return from a public service enterprise is that measure of profit which would be realized from any other business where the risks and capital investment are the same. What this is in any given case depends of course upon the peculiar circumstances of that case.

There has been much diversity of opinion as to what is a «fair valuation of the property devoted to the public service.» Several different standards for measuring that valuation have received recognition. (1) First, it has been urged that the total original cost of the plant and improvements should be deemed the true valuation. There are many objections to this test. Except in the case of newer enterprises the original cost cannot usually be determined with any accuracy. Furthermore, in such a figure may be included various items representing unwise or unnecessary expenditure which ought not to be made the basis of earnings at the present time. (2) The present capitalization of the business is also suggested as a measure of public utility valuation. This, however, overlooks entirely the not infrequent fact of over-capitalization, an abuse which public control has only begun to mitigate. There is too little relation between the capitalization and the actual investment in public service companies. (3) Another proposal is to take as the proper valuation the cost of reproducing the plant less the existing depreciation of the equipment. Opinions differ as to whether this should be the cost of reproducing the original plant, perhaps with a somewhat antiquated equipment, or the cost of reproducing a new and modern plant. (4) Perhaps the weight of authority inclines to the view that «fair valuation» means the present value of the plant as a going concern. This includes two elements, the physical valuation of the equipment and an additional increment representing the fact that the system is actually operating and producing earnings. It seems clear that any attempt to arrive at a fair valuation of a public utility investment must begin with an accurate appraisal of the value of the physical property. This fact has received a somewhat belated recognition and there is now a widespread tendency throughout the several States in the United States to provide for the making of such a valuation on a scientific basis. In estimating the value of the business as a going concern it must be borne in mind that the value of the public utilitity franchise should be excluded. This franchise value is directly based upon the capacity of the corporation to earn profits and it would accordingly be absurd to include it in the valuation upon the basis of which those profits are to be computed. The Supreme Court of the United States has declined to adopt any one of the above methods of determining the fair valuation of the property devoted to public service but has declared that all of them are to be given consideration. In Smyth v. Ames (169 U. S. 466, 1898), the court said: «In order to ascertain that value, the original cost of construction, the amount expended in permanent improvements, the amount and market value of its bonds and stock, the present as compared with the original cost of construction, the probable earning capacity of the property under particular rates prescribed by statute, the sum required to meet operating expenses, are all to be given such weight as may be just and right in each case. We do not say that there may not be other matters to be regarded in estimating the value of the property.»

Regulations to Secure Equality of Service.— Inequality of service rendered by public service corporations may take three forms: First, the arbitrary refusal to some of service rendered to others; second, the rendering of service of unequal quality for the same charge, and third, the charging of higher rates for the same service rendered under substantially similar conditions. The illegality of the first two forms of discrimination has long been established, but discrimination in rates has been made illegal *per se* only in relatively recent years. Under the early common law one who was not charged a rate unreasonable in itself had no cause of complaint because some one else was charged less. This rule was later modified so as to make discrimination in rates *prima facie* evidence of the unreasonableness of the higher rate charged. Finally, such discrimination came to be recognized as contrary to public policy and has been made illegal by statute practically everywhere.

The task of defining what is meant by discrimination, however, has not been easy and the different solutions of the problem arrived at by different legislative bodies have produced a highly variegated system of regulations upon the subject. Furthermore, it is not feasible to forbid discrimination of all kinds since absolute uniformity of rates is undesirable, and it has been necessary, therefore, to leave some leeway in the laws and regulations so that this legitimate discrimination may exist. The result has been to cast upon the courts a heavy burden in deciding in a multitude of concrete cases whether or not the particular discrimination complained of is forbidden by the statute. The Federal Interstate Commerce Act, for example, enumerates a considerable list of discriminations which are illegal when practised by common carriers upon those "in substantially similar circumstances and conditions," a phrase evidently designed to give a large measure of elasticity to the enforcement of the law.

The forms of discrimination in rates which are now commonly forbidden by law are the following: (1) Discriminations for the purpose of destroying competition, such as the offering of lower rates to a competitor's patrons to induce them to abandon him; (2) concessions made to large customers when the difference lies not in the amount of service rendered at any one time but merely in the total amount during a given period of time; (3) concessions made to exclusive patrons as against those who divide their patronage; (4) discriminations in favor of special kinds of business when the service rendered is the same, as when a railroad charges less for the shipment of goods to be used for one purpose than for another in order to develop particular industries in certain communities.

On the other hand, the law very generally recognizes the legitimacy of certain forms of discrimination. Among these may be mentioned the following: (1) Rates may differ where the services rendered entail different costs. Extra charge may be made, for example, for transportation on a train of unusual speed. (2) Lower rates may be charged for services rendered in units which entail less cost and inconvenience. A carload of goods may be shipped at a cheaper rate than a single package, or a large party may be given reduced passenger rates. (3) Rates may be lowered for patrons who themselves furnish a portion of the public utility facilities, such as cars, wharves, etc. All such discriminations are, however, closely scrutinized and strictly limited.

Special Regulations in the Interest of Public Convenience.— This point has already been touched upon in discussing the duty resting upon public service companies to furnish adequate service and suitable facilities and need not be further elaborated here. Legislatures have passed numerous and highly various laws of this kind. An illustration in point is the requirement sometimes found compelling the establishment of certain relations in the interest of public convenience between connecting railroads.

Machinery of Public Utility Regulation — Commissions.— Experience has demonstrated beyond doubt that public utilities can be effectively regulated neither by State legislatures nor by courts. As public utilities increased in number and in the complexity of their relations to the public welfare it became apparent that some machinery of control was necessary which would remove the problems of their regulation from partisan politics, protect the public in the matter of rates and service, protect the public utility itself from ill-advised attacks of legislative majorities and secure a scientific, efficient and impartial supervision which should be based upon an examination of facts. It is now universally recognized that these needs are best met by the creation of public utility commissions, modeled roughly after the Interstate Commerce Commission, and such organizations exist in all but one or two States of the Union for the regulation of at least the more important types of public utilities such as common carriers.

These commissions are usually, though not invariably, appointed by the State governor and are supposed to be non-partisan in personnel. The membership varies in number from three to seven, and the term of office varies from 2 to 10 years. The salaries paid range from $1,500 to $15,000. It is almost universally provided that no one who has any direct or indirect pecuniary interest in the public utilities over which the commission has jurisdiction may be a member of it.

The powers of public utility commissions may be grouped under four heads. In the first place, the commissions exercise power over public utility franchises. This power may include the determination of the necessity of granting new franchises, the control over franchise terms and the enforcement of the obligations resting on the public service company. In the second place, control is exercised in some States over the issuance of stocks and bonds of public utility companies for the purpose of preventing over-capitalization. In the third place, the commissions have authority over rates and service. Their powers in this respect differ widely in the several States. They have commonly, however, the right to make detailed investigations and conduct hearings for the purpose of securing data upon which to determine what rates may be charged or what service required. The orders issued upon these points are not final but may be reviewed by the courts. They are, however, regarded as *prima facie* reasonable and will be nullified only when clearly unreasonable. Finally, public utility commissions are empowered to require public service companies to adopt a uniform system of accounting and periodically to file detailed reports.

The regulation of public utilities by commission has not escaped criticism. Reference is made to the delays resulting from the system of appealing to the courts so large a proportion of the orders of the commission. It is pointed out that rates have not, as a rule, been materially reduced under this form of control. It has also sometimes happened that State public utility commissions have evinced an unfriendly attitude toward the public ownership of municipal utilities and have used their powers to block the progress of that movement. But on the whole it is generally conceded that commissions afford the only solution for the public utility problem. It has succeeded in large measure in taking the problem out of politics, has brought about very general improvements in service, and by creating an administrative agency of more or less expert ability has provided a means for dealing in a scientific manner with the perplexing problems relating to public utilities which remain as yet unsolved.

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PUBLIC WORKS, School of. See Polytechnique, The.

PUBLICANI, pŭb-lĭ-kā'nī, Roman farmers of the public revenues. In ancient Rome the privilege of collecting revenues from foreign districts dependent upon Rome was sold at auction by the censors for a period of five years. The security required by the state from these tax-gatherers was usually the price at which they had purchased the branch of the revenue to be collected and frequently was far in excess of the wealth of any single bidder, which resulted in the formation of companies for the purpose, called *socii*. Their business with the state was conducted under the name of one member designated the *manceps*. The farmers of the revenue were of the wealthiest classes. None but Roman citizens could be a member of the publicani and magistrates and governors of provinces were not eligible. The revenues were derived principally from tolls, tithes, mining duties and *scriptura* (tax levied for the use of the public pasture lands). The collections were made by an inferior class who were often freedmen or slaves in the employ of the company and were cordially detested by populace. The high price paid for the privilege and the greed of the publicani resulted in great injustice which together with the character of the collectors explains the bitterness with which they are mentioned in the New Testament. From about 150 B.C. they were usually of the equestrian order. Consult Greenidge, A. H. J., ‘Roman Public Life’ (London 1901); Livy (xxiii, 49; xxiv, 18); and the article «Publicani» (in Smith, William, ‘Dictionary of Greek and Roman Antiquities,’ Vol. II, 3d ed., London 1891).

PUBLICITY OF POLITICAL EXPENSES. See Corrupt Practices Acts.

PUBLICK OCCURRENCES, the first newspaper published in America, though it can hardly be called a newspaper, as no second number appeared, the colonial authorities suppressing it four days after its first appearance. It was issued at Boston 25 Sept. 1690 by Benjamin Harris and printed by Richard Pierce. As far as is known, there is only one copy extant now which is in the archives of the Public Record Office in London. A reproduction of it is contained in Green, S. A., ‘Ten Fac-simile Reproductions Relating to old Boston and Neighborhood’ (Boston 1900). See Newspapers, American.

PUBLICOLA, Publius Valerius. See Valerius, Publius.

PUBLISHERS' ASSOCIATION. See Newspapers, American.

PUBLISHING, American. The book trade or publishing industry in the New World had its origin in a more remote period than is generally supposed. It began within 100 years of the invention of printing, and from the date of the first American book, 1535, to the year 1799, over 7,000 different books had been published, nine-tenths of them, however, being pamphlets. The 19th century saw almost the full development of book publishing, the establishment of colleges and schools and the founding of many libraries, creating an ever-increasing demand for the best in literature.

Early American Books.— The first book printed on the American continent is said to have been ‘La Escalera Spiritual de San Juan Climaco,’ published in Mexico in 1535. It was a translation from the Latin into Castilian. Other books were printed on the first press set up in Mexico and six or seven books are known to have been published in Peru before 1600. In the United States the earliest publication was a pamphlet called ‘The Freeman's Oath,’ printed in Boston in 1639. This was followed in the year 1640 by the ‘Bay Psalm Book,’ printed by Stephen Daye at Cambridge, Mass. After its publication in the colony it was reprinted in England, where it went through 17 editions, the last one bearing the date of 1754. It was also a highly popular work in Scotland, 22 editions having been printed there, the last dated 1759. The first original American book published in this country was Mrs. Anne Bradstreet's ‘Poems,’ and this volume, issued in Cambridge, Mass., in 1640 was republished in London in 1650. Cambridge remained the only publishing town for a long time, and for 21 consecutive years issued about one volume a year. In 1653 Samuel Green published John Eliot's famous ‘Catechism’ in the Indian language, followed in 1659 by the Psalms in Indian, in 1661 by the Indian New Testament and in 1663 by the whole Bible in the Indian tongue. This was the first Bible printed in America.

Early Publishers.— In New York City the original book publisher was William Bradford, who became official printer in 1693, for «40 pounds a year and half the benefit of his printing, besides what served the public.» In 1694 he issued the ‘Laws of the Colony,’ the first bound book published in New York. In 1738 Christopher Sauer established a publishing house at Germantown, Pa., and issued the first German Bible printed in America in 1743. The firm of Little, Brown and Company was established in 1784 in Boston while in the following year, in Philadelphia, Lea Brothers and Company and Henry Baird and Company began business. It was also in 1785 that S. E. Bridgeman and Company began publishing books at Northampton, Mass. The existing house of J. B. Lippincott and Company was established in Philadelphia in 1798. The firm of Harper and Brother began business in New York in 1817. From this date the publishing business had a rapid growth, among the firms established being the following in New York: Baker, Voorhis and Company, 1820; D. Appleton and Company, 1825; D. Van Nostrand, 1830; Ivison and Company, 1831; John Wiley and Sons, 1832; John F. Trow, 1835; A. S. Barnes and Company, 1838. In other cities the early firms included the following: Cincinnati, Ohio, U. P. James, 1831; Springfield, Mass., G. and C. Merriam Company, 1831; Louisville, Ky., John P. Morton, 1825; Richmond, Va., J. W. Randolph Company, 1831; Mobile, Ala., G. H. Randall, 1831; Montgomery, Ala., Joel White and Company, 1833; Lancaster, Pa., John Baer's Sons, 1817.

The Early Book Trade.—As an adjunct to publishing, the selling of books originated in Boston as early as 1652, when Hezekiah Usher opened the first shop. Many colonial booksellers printed and published their wares. Benjamin Franklin (q.v.) was among the early book printers. In 1732, Richard Fry, an English man and bookseller of Boston, advertised: «Whereas it has been the common method of the most curious merchants of Boston to procure their books from London, this is to acquaint these gentlemen that I, the said Fry, will sell all sorts of accompt books, done after the most acute manner, for 20 per cent cheaper than they can have them from London. . . . For the pleasing entertainment of the polite parts of mankind, I have printed the most beautiful poems of Stephen Duck, the famous Wiltshire poet. It is a full demonstration to me that the people of New England have a fine taste for good sense and polite learning, having already sold 1,200 of these poems.» The first convention of booksellers for the regulation of trade seems to have been held in Boston, 1724; it was for the special purpose of increasing the prices of certain works. Toward the close of the century bookselling began to take rank among the most considerable commercial pursuits, though it then only foreshadowed its present comparative importance. Works of standard character, involving large expenditures, were undertaken by publishers, who, in such cases, usually subscribed together as a guarantee for the printer's outlay. The trade was conducted upon established principles, and innovators were held in poor esteem. All these usages were, however, disturbed by competition, and after the publication of the Waverly novels, of which rival editions were issued, the individual members of the trade acted more independently of each other, and their customs afterward partook of a less narrow spirit. The American Company of Booksellers was founded in 1801. Books were formerly sold in sheets, to be bound as purchasers might desire, a practice which no longer obtains. The universal diffusion of education in America, and the inquiring mental character of its people, not only increased the circulation of books but reduced their price, and the old-fashioned veneration which literary works had once inspired experienced no little modification. Externals were of small consequence to the great body of readers, and works were purchased not so much for preservation as for immediate reading.

Statistics.— From 1825 to 1840 the number of American publications show an aggregate of 1,115. Of these 623 were original and 492 were reprints from foreign works. The population of the United States in that year was about 17,000,000. In 1853, 733 new works were published in the United States, of which 278 were reprints of English works, 35 were translations of foreign authors and the remainder were original American works. The population of the United States had reached about 25,000,000, an increase of 50 per cent compared with 1840. The original American works published in 1853, compared with the 15 years ending in 1840, show an increase of about 800 per cent in less than 20 years. In other words, the original American publications of the book trade seem to have advanced about 15 times as fast as the population. In 1880, with a population of 50,000,000, the new books published during that year amounted to about 2,000 — nearly three times more than in 1853, whereas the population had only doubled. The total number of new books published according to the records of the *Publishers' Weekly*, for the years given below, is as follows:

1881	2,991	1896	5,703
1882	3,472	1897	4,928
1883	3,481	1898	4,886
1884	4,088	1899	5,321
1885	4,030	1900	6,636
1886	4,776	1901	8,141
1887	4,437	1902	7,833
1888	4,631	1903	7,865
1889	4,014	1909	10,901
1890	4,559	1910	13,470
1891	4,665	1911	11,123
1892	4,862	1912	10,903
1893	5,134	1913	12,230
1894	5,134	1914	12,010
1895	5,469	1915	9,734

It will be observed that there is a heavy falling off for 1915, due to abnormal conditions brought about by the war. While the number in other classes was unusually small, books of history numbered 758, as compared to 581 in 1914, the increase being due to the many publications on the war.

As an illustration of normal conditions in the book trade the figures for 1914 are of more value. Of the total number of titles published during this period, 10,175 were new books and 1,835 were new editions. Imported books, editions printed abroad, but bound in this country, numbered 2,852. Of the various classes fiction leads. The output for 1904 may be compared to that of 1914 by the chief classes, showing the change in public demand within the past 10 years:

	1904	1914
Fiction, American	1,262	689
Fiction, foreign	559	364
Law	614	507
Education	628	268
Theology	717	1,032
Philosophy	58	408
Sociology and Economics	336	1,038

Considering only the books of American authorship for 1914, it will be seen that there is some change in the relative proportion of classes. Books on sociology and economics take the lead, fiction coming second almost 200 titles behind.

Books by American Authors Published in 1914.

CLASS	No. of titles
Sociology and economics	876
Fiction	689
Religion and theology	677
Poetry and drama	558
Applied science	552
Science	509
Law	483
Medicine and hygiene	414
Juvenile books	405
History	400
Biography, geneology	391
General literature and essays	389
Geography and travel	340
Agriculture	335
Philosophy	290
Education	237
Business	199
Philology	190
Fine arts	166
Games, amusements	155
Domestic economy	119
Music	70
Miscellaneous	119
Total	8,563

Popular Books.— In 1903 there were 1,700 book publishers in the United States. While Boston and Philadelphia remain true to their earlier reputations as leading book centres, New York has become the largest book mart and the leading factor in the manufacture of books. Chicago too has assumed an important place in the book trade, while some hundreds of books are published annually in Cincinnati, San Francisco, Cleveland and other smaller cities. The majority of American books are published by 100 firms in New York, Boston, Chicago and Philadelphia. During 1902 and 1903 the historical novels enjoyed widespread popularity, and nine books of this class circulated to the extent of 1,400,000 copies. This enormous output, however, did not lessen the sale of older and more standard books. These were largely reprints. A popular work 75 years after its first publication is often found to have been reprinted 20 times by as many different publishers. Of the world's great standards, hundreds, and in some cases thousands, of editions have appeared. There is, nevertheless, a distinction to be made between the manufacturer of books who takes old works and reprints them, and the publisher who issues entirely fresh and original matter. Among early successful books Mrs. Stowe's 'Uncle Tom's Cabin' had a phenomenal sale, 500,000 copies being sold in less than five years in the United States, and by April 1852 more than 1,000,000 had been reprinted in Great Britain. Of Longfellow's poems, without taking into account unauthorized English reprints, the American sales in 1839–57 amounted to 325,550; from the latter date till 1901, 220,000.

School Books.— No small factor in bookmaking during the 19th century was the phenomenal production of school and college textbooks. In 1902 the reports showed a list of 433 educational works, while in 1904 this was increased to 628, though there has since been a marked decline in the production of this class. Of books for use in the public schools editions of 500,000 copies, intended for one year's consumption, are not an unusual event. Messrs. D. Appleton and Company for many years sold over 1,000,000 copies of Webster's 'Speller' every year; and W. B. Smith and Company of Cincinnati, Ohio, sold over 1,000,000 copies of the Eclectic Series during each year. The electrotype plates of schoolbooks, Bibles, prayer-books and hymnbooks, are very rarely changed and enormous quantities are sold every year.

Miscellaneous Books.— In the United States many encyclopedias, dictionaries, the complete works of standard authors in definitive editions, anthologies of literature, etc., are sold by subscription; and the initial expense of such books being enormous, before a single copy of the book is made, the sales must be enormous also. Then there are many «books which are not books» — such as city directories, which are usually published by a company devoted exclusively to the publication of this one book; State directories, list of dealers in each business and commercial agency reports (each of these agencies makes four revised editions of its books each year, each book measuring about 11 by 13 inches, and containing about 2,500 pages of matter in close print). There are also innumerable genealogies, indexes, catalogs, together with many other productions which are truly books, but which cannot be called literature.

Commercial Value.— In the publishing of books the following are the items of outlay which need to be taken into account: Copyright, paper, typesetting, author's corrections, electrotyping, press work, binding, advertising. Publishing means a great deal more than merely printing and binding a book. It means putting it where it is likely to sell. The machinery of distribution, which means the method of getting books finally into the hands of readers through the various middlemen, is vastly important. The manufacture of a book now demands the assistance of various branches of mechanical skill. Besides the paper-maker, the type-founder and the printer, to whom it gives a large proportion of employment, it engages, exclusively, the bookbinder. Its material form has, till the present era of cheap publications, always borne a commercial value extravagantly disproportionate to its matter.

Copyright.—A common arrangement between the American author and publisher is a payment of 10 per cent royalty on the retail price of all sales; sometimes a cash sum is paid, and the publisher secures the copyright, which is granted for 28 years, subject to renewal by the author, his widow or children for other 14 years. A condition is that a copy of a title-page must be registered with the librarian of Congress, and two copies of the book lodged there not later than the day of publication. The entry fees are 50 cents for an American author, $1 for a foreigner and 50 cents additional for a certificate of record. A copy of any new edition must also be sent to the librarian. (See COPYRIGHT). By the provisions of the International Copyright Act (1886), a foreign author's rights are protected in Great Britain, Belgium, France, Germany, Haiti, Italy, Spain, Switzerland and Tunis. Colonial authors can also secure copyright without publication in the United Kingdom, and a work copyright in the United Kingdom is copyright in Canada. American cheap reprints of British books are admitted to Canada subject to a customs duty of 12½ per cent, to be paid over to the British author, but the returns from this source have been very small.

Bookbinding.— Since 1885, in the bookmaking industry, many improvements have been made in wire-stitching machines. One of these machines will stitch anything from two sheets to a book two inches thick, and with several of them either round or flat wire may be used. There has also been introduced a noteworthy combination folding and wire-stitching machine, which, by a continuous and automatic operation, takes the sheets from the feeders, and folds, gathers, collates, covers and wire-stitches them. Paper-cutting machines have been improved by the introduction of automatic clamps, indicators and gauges. The invention of a steam rounding and backing machine has increased the capacity of from 500 to 1,000 books per day to a capacity of from 5,000 to 6,000 in the same time. The latest case-making machine feeds itself from a roll of cloth which it automatically cuts into pieces of proper size for use. The cloth is first covered with glue by contact with a cylinder revolving in a pot of glue. It is then cut by the machine and nicked in corner sections; boards are supplied from a holder and a back lining from a roll, both receptacles forming part of the machine. This process completed, the nearly finished product drops a little, the cloth is folded over the boards and back lining, and the binding, after passing through a case smoother, is delivered in a finished state. Among other inventions are a casting-in machine, for putting the body of a book into its cover, and a gathering machine. This latter invention promises important developments in economy. See BOOKBINDING.

Book Plates.—About the year 1804 the art of stereotyping was invented in England, and in a few years was introduced into this country. With the type-printed book under the old conditions a publisher did not dare print a large number of copies of any book unless he believed it would have a quick sale. Books were bulky and took up too much space. Consequently, the types for a first edition were distributed when they left the press; then had to be reset with renewed chances of error in the second edition. Resetting for two or more editions added largely to the cost of the book and limited its supply. The process of stereotyping first used, known as the plaster process, served book printers for about 50 years. The practice of the art was brought to New York by David Bruce in 1813, but the first book stereotyped in America was the 'Westminster Catechism,' made by J. Watts and Company of New York in June of the same year. For the printing of books, all methods of stereotyping have been superseded by electrotyping, which was experimentally tried in New York as early as 1841, and was in general use before 1855.

Book Imports.— The summary of the chief imports of books and other printed matter for 1909 and 1914 shows the following:

VALUE OF BOOKS, ETC., BOTH FREE AND DUTIABLE, IMPORTED IN 1909 AND 1914.

IMPORTED FROM	1909	1914
United Kingdom	$2,819,302	$3,540,824
France	394,620	566,572
Germany	1,671,679	1,416,658
British North America	167,262	120,007

Book Exports.— The books and other printed matter of domestic manufacture exported from the United States during 1909 and 1914 represent the following:

COUNTRIES TO WHICH EXPORTED	1909	*1914
United Kingdom	$1,334,499	$1,554,698
Belgium	37,116	32,609
France	229,129	86,476
Germany	141,562	235,920
Italy	29,576	32,992
Netherlands	16,093	24,780
Other Europe	59,566	106,216
British North America	2,658,380	4,905,329
Central American States and British Honduras	88,454	169,795
Mexico	245,453	321,914
Cuba	325,599	239,359
Other West Indies and Bermuda	49,101	37,917
Argentina	97,606	130,661
Brazil	230,353	227,866
Chili	68,856	109,509
Other South America	134,921	236,222
Chinese Empire	50,480	143,743
British East Indies	22,813	35,110
Japan	67,371	115,962
British Australasia	260,079	376,721
Philippine Islands	156,199	317,995
British Africa	22,823	38,734
All other Africa	5,302	6,455
Other countries	20,114	152,877
Totals	$6,351,445	$9,639,860

* Year ends 30 June, just before war began, thus covering period of normal conditions.

During the two decades from 1894 to 1914 the only striking change recorded in the book-publishing trade was the enormous and phenomenal circulation of popular novels. During this period the advance in good taste and in artistic beauty of product was a marked characteristic of the industry. Fashions in bindings changed annually, but a widening range of materials and patterns, more daring use of designs and inks, and the invention and general use of automatic binding machinery supplemented improvements in printing, permitting lower prices for books and promoting phenomenal sales. It is a significant coincidence that the decade which witnessed extraordinary advance in all details of mechanical productions in this industry should be characterized also by the most noteworthy advance in the good taste and appreciation of the general public.

CHARLES H. COCHRANE.

PUCCINI, pû-chē'nē, **Giacomo**, Italian operatic composer: b. Lucca, Italy, 22 June or 23 Dec. 1858. He came of a family of distinguished musicians, his great-great-grandfather Giacomo, his great-grandfather Antonia, grandfather Domenico and father Michele all being famous. He was educated at the Conservatory at Milan, studying under Bazzini and Ponchielli. His first opera, 'Le Villi' (1884), was produced at the Teatro del Verme and was favorably received. His 'Edgar' (1889) was produced at La Scala, but his first great success was with 'Manon Lescaut' (1893) at Turin. Three years later his 'La Bohème,' also produced at Turin, achieved an extraordinary success and won world-wide fame for its author. 'Tosca' (1900) was followed by 'Madame Butterfly' (1904), with which the composer again scored a triumph. His ‹Girl of the Golden West› (‹La Fanciulla del West›) enjoyed signal success at the Metropolitan Opera House, New York. The European War interrupted the production of his new compositions, but ‹La Rondine› and ‹I Due Zoccoletti› were both completed in the first year of the war. His work is highly original and he ranks among the foremost modern Italian composers.

PUCK, in mediæval mythology, a celebrated fairy of mischievous tendencies whose character and attributes are depicted in Shakespear's ‹Midsummer Night's Dream.› This fairy is known by a variety of names, as Robin Goodfellow and Friar Rush in England, and in Germany as Knecht Ruprecht; but it is by his designation of Puck that he is most generally known in England, Germany and the more northern nations. He was the chief of the domestic tribe of fairies, or «brownies,» as they are called in Scotland and innumerable stories are told of his nocturnal exploits.

PUD. See Pood.

PUDDING-BERRIES, the berries of the Canadian dogwood (*Cornus canadensis*), common throughout North America. See Dogwood.

PUDDINGSTONE. See Conglomerate.

PUEBLA, pwāb'lä, a state of Mexico. The state of La Puebla in the central plateau of the Anahuac has Vera Cruz to the north and east, Oaxaca to the south, Guerrero to the southwest and Morelos, Mexico, Tlaxcala and Hidalgo to the west. The area is 12,204 square miles. Pop. 1,101,600. (See Mexico). Consult Palacios, E. J., ‹Puebla su Territorio y sus Habitantes› (2 vols., Mexico 1917).

PUEBLA, Mexico (originally called La Puebla de los Angeles, more recently Puebla de Zaragoza), capital of the state of the same name, 116 miles east of the City of Mexico by the Mexican Railway, but only about 60 miles in a straight line; altitude over 7,000 feet above the sea. The climate is most agreeable, the maximum temperature being 84° in summer and 75° in winter. The peaks Popocatepetl and Ixtaccihuatl are only about 25 miles distant and those of Orizaba and Malinche are in plain view. Three steam railways,— the Mexican, the Mexican Southern and the Inter-Oceanic and electric street railways supply transportation. Straw hats, leather goods and numerous other articles are manufactured in considerable quantities, and in the immediate vicinity are several large cotton mills. Near by are the famous onyx quarries which have for many years supplied great quantities of beautiful onyx to Mexico and the United States. A manufactory in the city makes of the product of these quarries and endless variety of useful or ornamental objects, from store and saloon fixtures, table tops and wash basins to imitations of every fruit known in the country. The banking facilities of the city are supplied by the Oriental Bank, with $8,000,000 capital, and a number of other financial institutions. The city is noted for its many churches, clean streets, substantial business edifices and grand cathedral, which was almost 100 years (1552–1649) in building, is 323 feet long, 101 feet wide and 80 feet from floor to roof.

The educational institutions besides the primary and high schools are the State College, School of Medicine, Normal School for Men, Normal School for Women, Normal School of Arts, Academy of Fine Arts and hospicio for the education of children. There are three public libraries, museum of archæology, an art gallery, an observatory, a market hall, sulphur baths, a general hospital, founded in 1658, and a maternity hospital, state hospital for both sexes, hospital for the insane, children's hospital, military hospital, Interoceanic Railway Hospital and Spanish Beneficiary Hospital. The palace of the state government, which faces the principal part or zocolo, is one of the notable buildings of the city. The extensive and very beautiful Alameda is a most attractive spot and contains a monument erected in 1898 in honor of Mexico's liberators, and the monument to Gen. Nicolas Bravo. There are also the French-Mexican monument erected by the French colony in 1902, and the equestrienne statue of General Zaragoza, which surmounts a fine monument erected at the foot of the hill of Guadalupe. In the Government Palace is a most interesting collection of historic paintings and a librarv of 28,000 volumes. The zocolo or central park of the city is artistically laid out in vine and foliage covered walks, with fountains and statues here and there, and numerous small plazas supply needed breathing spots. There are three theatres, one of which, the «Teatro Principal,» was built in 1790 and claims to be the oldest theatre on the American continent. Since 1532, in which year the royal sanction was given to form a settlement here, Puebla has occupied second place among all the cities of the land, commercially, spiritually and in population, until very recently, when Guadalajara forged ahead in population and material development generally.

The city of Puebla was founded in 1532 by the Franciscans, and is considered the military key to the capital of the republic. During the war between Mexico and the United States it was captured by Gen. Winfield Scott, who made his headquarters there from June to August 1847. It was captured by the French in 1863 and recovered by the Republican forces under Gen. (later President) Porfirio Diaz, in 1867. Tradition asserts that when Cortez came he found a city of 300,000 inhabitants, 400 temples and a legion of priests, six miles distant from Puebla, where now is the famous Pyramid of Cholula; and that the Aztecs came there in great numbers to worship and offer up human sacrifices. Pop. about 96,121. Consult Carrión, A., ‹Historia de la Ciudad de la Puebla de los Angeles (Puebla de Zaragoza)› (2 vols., Puebla 1897).

PUEBLO, Colo., city, county-seat of Pueblo County, and second city in the State, on the Atchison, Topeka and Santa Fé, the Colorado and Southern (Burlington Route), the Denver and Rio Grande, the Missouri Pacific and the Chicago, Rock Island and Pacific railroads, also on the Colorado-Kansas Railroad, about 120 miles south by east of Denver. Within its corporate limits are several former villages: North Pueblo, Central Pueblo, South Pueblo and Bessemer. It is in a valley on the eastern foothills of the Greenhorn Range of the Rocky Mountains. The old fort at Pueblo was built about 1840, and here came the agents of the American Fur Company (John Jacob Astor's Company) to trade with the white trappers and Indians for their furs. In 1846 there were 100 white people located here engaged in raising crops, and a real trading post was established in 1850. In 1854 the Ute Indians massacred the residents of the post. In 1859 the present city was laid out, and in 1873 it was chartered as a city. The region of country east is largely devoted to agriculture and stock-raising. In the vicinity of the city are extensive coal and oil fields and deposits of limestone and ores. The silver and copper ores are brought to the smelters of Pueblo; and lead, gold and zinc are here prepared for the metals of commerce. The iron and steel industries have become quite extensive. The Colorado Fuel and Iron Company (steel plant) have 6,500 employees; the railroad car-shops and yards, 3,200 employees; the smelters, 2,200; the foundries and other manufactories, 6,000. There are invested in manufacturing industries a capital of about $18,000,000, and the products are about $65,000,000.

The principal public institutions are the State Insane Asylum, Saint Mary's Hospital and Sanatorium (1,000 patients annually), Minnequa Hospital (cost $300,000), and private sanatoriums. There are two systems of public schools, one on each side of the river; two high schools, public and parish schools (16,000 school children), Loretto Academy, the McClellan public library with 14,000 volumes, law libraries, school libraries, and the State Mineral Palace and Park. A complete collection of the minerals of Colorado are in the Mineral Palace. The five banks have a combined capital of $800,000 and deposits of over $15,000,000. The government is administered under a special charter, adopted 19 Sept. 1911, amended 4 Nov. 1913 and again on 2 Nov. 1915. The charter provides for three commissioners, who select appointees from lists furnished by a civil service commission, which holds examinations twice a year. The civil service commission consists of three members, who are elected by the people. The police judge and city comptroller are appointed by the civil service commissioners and are not civil service officers. Their term of office is four years. The city clerk, city attorney and city engineer are appointed by the council, which is made up of the three city commissioners. They are not protected by civil service and are appointed for four years. The city commissioners are elected for four years and the civil service commissioners for six years. Elections are biennial; one city commissioner is chosen at one election and two at the succeeding election. The city owns two systems of waterworks, which are operated by trustees elected by the residents of those water districts. The large majority of the population are native-born Americans; about 2,000 are Italians; 1,000 are Austrians, and 1,500 are colored. Pop. 73,000.

P. A. Gray,
Secretary of Pueblo Commerce Club.

PUEBLO INDIANS (Spanish, «town,» «village»; hence Pueblos, «villagers»), a group of sedentary agricultural tribes comprising the Tanoan, Keresan or Queres, and Zuñian linguistic stocks in New Mexico, and the Hopi or Moqui of the Shoshonean stock in northeastern Arizona. There are also some Mexicanized remnants of the Tanoan stock on the Rio Grande below El Paso, in Texas, and Chihuahua. For details see under the above stock names.

Physical Characters.— Disregarding those who have been more or less affected by Spanish contact, the Pueblo Indians are generally small in stature, particularly the women, some of whom are quite diminutive. After marriage the latter frequently become stout, but obesity is rare. The men are a rich brown in color, not so dark nor so reddish as their Navaho neighbors. The women are lighter, many of them being of a fine olive tint, which, with regular features and often with eyes almost oriental in type, make them decidedly comely. Albinism is common among the Hopi and Zuñi, those of the latter tribe averaging one in 200. The hair is thick, black and glossy. That of the men is cut «terrace fashion,» that is, banged across the forehead, cut horizontally at the sides on a line with the chin, and allowed to grow to full length behind, but knotted and tied into a short queue. This is probably the more primitive style of hair-dressing, but it now varies more or less with the tribe. The front hair of the women is cut level with the chin, parted laterally, and allowed to fall over the face, necessitating continual brushing aside with the hand to permit them to see. The unmarried Hopi girls retain the primitive method of wearing the hair in large whorls over the ears.

Dress.— The costume of the men, now largely superseded by the clothing of civilization, consisted of a shirt, a poncho-like coat formed of a squarish piece with a hole in the middle for the head, and sewed down the sides, with partly open sleeves; a pair of loose trousers reaching below the knees, open half-way up the outer sides and fastened with a belt; footless stockings, leggings, garters, moccasins or sandals, breechcloth, headband, hairband, and blanket. Dressed skin or native cotton formed the chief materials from which their costumes were made, but these gave place largely to woolen articles after the introduction of sheep by the Spaniards. The woolen blanket of later times was probably preceded by a robe made of strips of rabbit or wildcat skin coarsely woven or plaited together. Yucca strips, feathers, and even human hair also formed raw materials for clothing. The typical dress of the women consisted of a skirt of skin or cotton (now of wool) reaching from the neck to below the knees, and girded with a belt, the right arm and shoulder being bare; a manta hanging loosely from the neck and down behind or thrown over the head; stockings, deerskin leggings, consisting usually of an entire skin wrapped many times around the calf, and sandals or moccasins, to which latter the leggings were attached. Among some of the Rio Grande Pueblos the women wear soft deerskin boots instead of the cumbersome leg-wrappings. Necklaces of seashell and turquoise beads, and pendants, ear-tablets, bracelets, and other ornaments were worn by both men and women, but the shell necklaces of the latter have been superseded by those of silver. Leather belts strung with large silver discs and silver-mounted wristguards are worn by the men who can afford them. Excepting the moccasins and leggings, skin has largely passed out

PUEBLO INDIAN VILLAGE

of use for clothing, cheap cotton prints and a woolen blanket being almost exclusively employed by the men.

Houses.— The typical pueblo is a many-celled, communal, defensive structure of several stories, opening on one or more courts or plazas in which dances and other ceremonies are performed. When the pueblo enclosed a single court, the outer wall was usually the highest, and was pierced with only small openings, or port-holes, to afford a view of the surrounding country. A slight elevation was usually preferred, but there are many instances in which the site is a lofty mesa or a level plain, while other dwellings were built in natural recesses in the rocky walls of cañons or cliffs, hence their popular designation, *cliff-dwellings*. The site depended on accessibility to water, to cultivable fields, or to the necessity for defense against enemies. Both rounded or polygonal structures were common, while some pueblos were semicircular in ground-plan, with a high rear wall and with the houses arranged in terraces, the tiers of dwellings successively retreating so that the roof of the lower formed the means of access as well as the «front yard» of the tier next above, and so on to the sixth or seventh story. The ground tier usually contained only small wall openings, access being gained by means of a movable ladder to the roof, which was provided with a hatchway. Most of the pueblos still follow this ancient form, but there are now but few whose ground-floor houses are not provided with doors and windows. Sometimes forming a part of and sometimes detached from the main house cluster, are chambers, wholly or partly under ground and usually circular, used in early times as gathering places and sleeping apartments by the men, and still employed for ceremonies and tribal councils. The fireplace was in the centre, the smoke escaping through the hatchway; so hot did these *kivas* become that the Spaniards likened them to stoves, hence their still popular name, «estufas.» The structural materials depended largely on the immediate supply. Slabs of sandstone, being abundant, were commonly used; they were sometimes neatly pecked and laid in adobe mortar or chinked with spalls, and although joints in the masonry were not «broken,» the result was frequently a marvelously straight and strong wall that has stood the ravages of centuries. *Pisé* construction was also employed in massive buildings, such as Casa Grande in southern Arizona. Molded adobe bricks, now so commonly used, were not made in pre-Spanish times, but balls of mud mixed with ashes and sage, and dried, were in vogue as a building material in pre-historic times. The roofs of the houses consist usually of pine or cottonwood beams, with light poles laid transversely, which in turn are covered with brush-grass, and adobe mud, well tamped. The introduction of the horse, which permitted the transportation of heavy roof beams, seems to have had a decided influence in increasing the size of the rooms, the compartments of the ancient structures being usually mere cells. Flakes of selenite were pieced together for window panes, but these have given way to stock frames purchased from the white traders, while the corner fireplace and chimney have been substituted for the central fire-pit, except in the kivas.

Industries.—As they are sedentary tribes, the Pueblos are agriculturists, their principal crops being corn, squashes, beans, and onions, to which were added wheat, watermelons, cantaloupes, grapes, peaches, etc., on the advent of the Spaniards. Corn is prepared in very many ways, and wild fruits form a not unimportant part of the Pueblo pabulum. Their meat supply was gained mainly through communal hunting, the mountains supplying bear, deer, antelope and elk, while the valleys and cañons abounded in jack-rabbits, cottontails, prairie-dogs, wild turkeys, quails, and doves. The buffalo was probably hunted to some extent by the Rio Grande Pueblos, who also conducted a brisk trade with the Plains tribes up to 25 years ago. For religious reasons, fish was probably universally tabooed, water, on which everything depends, being a sacred element. The turkey was domesticated, and eagles were and still are kept in captivity for their feathers. Cattle, sheep, goats, horses, and asses, which now form such an important part in the Pueblo economy, were unknown before the Spaniards went among them. The Pueblos are a provident people, their reserve food supply usually being sufficient for a year's use, thus succoring them in event of drought. Most of their agriculture is conducted by means of irrigation, although patches of corn, melons, squashes, etc., and small peach orchards are otherwise successfully cultivated in favorable localities. The Hopi raised large quantities of cotton, which they wove into garments and traded with other tribes. Indeed they are still the leading cotton weavers among the Pueblos, the industry probably having been introduced by clans from the far south. The Hopi and Zuñi also weave excellent blankets, sashes, dresses, garters, etc., of wool, and a few of the Zuñi men are expert silversmiths. The basket trays of the Hopi are noteworthy, although the art has greatly declined since the introduction of aniline dyes. Some of the other Pueblos make a coarse basket for domestic use. As potters the Pueblos are far in advance of all other Indians north of Mexico. Purely primitive methods are still employed, and the decorative motive is generally symbolic, intricate, and pleasing.

Social and Religious.—All the Pueblo tribes are composed of numerous clans, named after some animal, plant, or other natural object or phenomenon. Maternal descent is recognized, that is, the children belong to the clan of the mother. Marriage, which is not allowed between members of the same clan, is generally effected by mutual consent of the contracting couple and their parents, and is sealed after an exchange of gifts and a simple primitive ceremony. The vow, however, is not very binding and divorce is merely a matter of mutual agreement, the offspring, if any, invariably belonging to the mother. The status of the Pueblo woman is high. She owns the house and its furniture, while it is the husband's duty to provide for his family and he frequently makes his wife's clothes. The dead were formerly cremated or were buried in the houses or in the refuse heaps. Now, however, the dead are buried in a common cemetery in front of the Catholic Church, except among the Hopi, who deposit their dead in crevices in the rocks. The social and religious organization of most of the Pueblos was considerably affected by the Spanish missionary and civil authorities, and among all the tribes except the Hopi a civil governor and other officers are now annually elected, although their power in some instances is only nominal. Originally the religious and social organization was inseparable; each clan had its priest or priest-chief, while both the internal and the external affairs of the tribe, where they affected the complicated and far-reaching religious organization, were controlled by a priesthood. There were also other socio-religious societies, grouped according to the several regions — north, south, east, west, upper, and lower — some of which assumed control over certain affairs in winter, others in summer. The members of these societies, where they still exist, are the medicine-men of the tribe, some of whose functions are the prevention as well as the cure of disease, the regulation of the communal hunts, the extermination of witchcraft, and the intermediation between the tribesmen and the many nature gods which form the Pueblo pantheon. Communication with these nature powers was and is still conducted by means of secret or open ceremonies, consisting of the depositing of prayer-sticks, chants, dances, sacrifices, pantomime, masquerade, and the recital of rituals.

History.— From the Pueblo tribes which have been more intimately studied it has been learned that they consist of many small accretions from various stocks and from many localities, which left their former homes on account of drought and the consequent failure of crops, through superstition, the depredations of enemies, or other causes. The migrations of these component clans or parts of clans were sometimes very slow, many years being consumed in their journeyings and village after village being successively built, occupied, and abandoned before the final settlement was made. Thus are many of the ruins of Arizona, New Mexico, Colorado, and Utah accounted for. The nuclei of some of the Pueblo tribes, however, had their mythical origin in the north, at a place called Sipapu, where they are supposed to return after death, and which is symbolically represented by an opening in the floor of the ceremonial chambers, in front of the altars erected during religious rites. Indefinite knowledge of a populous region in the north gained by the Spaniards in Mexico early in the 16th century led first to the journey in 1539 of Fray Marcos de Niza to the «Seven Cities of Cibola,» the present Zuñiland, followed a year later by the expedition under Coronado. This was the first direct contact of the Pueblo Indians with the whites. For the successive Spanish expeditions and the later history of the Pueblos, see New Mexico, and also the subjects mentioned below.

Population.—At the time of Coronado's visit the Pueblo tribes were said to inhabit 66 villages and to number 20,000 men, but it is doubtful if the entire population exceeded this estimate. With the exception of Acoma and Isleta none of the 28 pueblos now existing occupy their 16th century sites, the remainder having been forced into new locations chiefly during the reconquest of New Mexico after the Pueblo revolt of 1680. The present aggregate population of the 27 villages is about 10,000, exclusive of several Hopi villages in Arizona and the two pueblos of Isleta and Senecu, below El Paso, which contain from 2,000 to 3,000 more. For their distribution see Keresan; Shoshonean Indians; Tanoan Family, and Zuñian.

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F. W. Hodge,
Museum of the American Indian, Heye Foundation.

PUELCHE, pwĕl'kē, South American Indian tribe of Araucan stock, living in the pampas region of the Rio Negro and the Rio Colorado in southern Argentina. They are a wild and warlike people, lead a nomadic life and know practically nothing of agriculture. They succeeded in driving away the Spaniards after the first settlement of Buenos Aires but later withdrew before the Spanish cavalry. They have great herds of cattle and horse, and their chief weapons are the bola and the lasso.

PUERPERAL ECLAMPSIA, a form of eclampsia occurring in pregnant women, usually arising from blood-poisoning and often fatal. The exciting causes may be many, but some form of increased irritability of the nervous system is one of the most important features of the condition. The symptoms come on suddenly, or following a headache, with irritability and perhaps slight impairment of sight or hearing, or with vomiting. Convulsions of an epileptic, hysterical or apoplectic variety constitute the main symptom. These convulsions may last for from one to five minutes, and are then usually accompanied by unconsciousness. They recur sometimes at very short intervals, most frequently hourly, and may vary from 10 to 30 or more in a day. Such convulsive seizures are always serious to both mother and child and prompt emptying of the uterus is the main remedy to be employed.

PUERPERAL FEVER, an infectious disease of women occurring shortly after childbirth, or following a miscarriage, accidental or induced. It is caused by a micro-organism, usually a bacterium (*Streptococcus*), and is communicated by contact with unclean hands, instruments or clothing which may have brought the infection, just before, during or after the birth of the fœtus. Only in the rarest of instances does it occur when due precautions as to absolute surgical cleanliness have been observed. It usually begins within a week after the termination of pregnancy, ordinarily from the third to the fifth day, and is attended with acute inflammation of the reproductive organs and with septic infection of the blood and body at large. It is always an infection from without, and is preventable by rigid aseptic midwifery. The symptoms will vary very widely according to the infecting organism and the severity of the infection. A slight amount of fever and some local extension of tenderness may be the only symptoms present in mild cases. In septicæmic cases there is usually a decided chill about the third or fourth day, and is attendant with acute inflammation of 102°, 103°, 104°, 105° F. with general depression and rapid pulse. The temperature usually remains high and then suddenly drops as the patient recovers. In the severest cases, the pyæmic infections, the blood-current becomes infected; chills, temperature, sweats occur and recur, and the patient usually dies. The treatment is purely medical, sometimes surgical, and needs the skilled physician and nurse. Prevention is the demand of the modern woman, and she is entitled to it. Unskilled and dirty midwives, unclean doctors and abortionists are responsible for practically all of the deaths due to childbed fever.

PUERTO CABELLO, pwär'tō kä-bĕl'yō, Venezuela, port and capital of the state of Carabobo, on a low peninsula jutting into the Caribbean Sea and forming one of the finest harbors in the world. A lighthouse and fortifications protect the entry. Railroads connect the city with Valencia, 22 miles southeast, and with Caracas, 78 miles east. The exports are coffee (six-sevenths of the whole), cacao, hides, cinchona, oxen, sugar, cotton, timber, including dye woods, and some copper ore. The city was the last stronghold of the Spanish (1823); it was blockaded by the German and British fleets in 1902–03, as the most valuable port of entry and the best place to collect their claims on Venezuela. Pop. (est.) 18,000.

PUERTO LA MAR, lä mär. See Cobija.

PUERTO PLATA, plä'tä, Santo Domingo, port of the Dominican Republic on the north side of the island of Haiti. The entrance to the harbor is extremely narrow. Steamship lines connect with Europe, Saint Thomas and Havana, and it is connected by rail with Santiago de los Caballeros. Puerto Plata is the export town of the rich tobacco, sugar and coffee plantations in the interior of the island. There are several valuable coal mines nearby and there is also an extensive trade in mahogany. A white cheesebox fort, a relic of the buccaneers, situated upon a small promontory, is the only defense of the town. Municipal authority is vested in a mayor and common council, elected by the people, the mayor being president of the council. The city has a police department, a school board and a very good school system and a street cleaning department. It is well lighted and has waterworks. The town was settled in the first decade of the 16th century by Spaniards. About 30 per cent of the population speak English. Population about 10,000.

PUERTO PRINCIPE, prēn'sē-pä, or **CAMAGÜEY**, Cuba, town, capital of the province of Puerto Principe, 170 miles northwest of the city of Santiago de Cuba. It was originally founded in 1515 at Nuevitas, the site of an old Indian village, on the northern coast, but was moved to its present site in 1516. For a time after 1800 it was the seat of government for the Spanish West Indies, and until the end of Spanish rule was an important military post. It is the largest inland city of the island, and is connected with its port, Nuevitas, by railroad. It is the centre of a cattle-raising district, and exports cattle, hides, etc. Sugar also is cultivated somewhat in the vicinity and exported. The town is very mediæval in appearance, the streets are narrow and the houses old. During the American occupation artesian wells were bored to obtain a pure water supply, the streets were repaired, a good drainage system introduced and buildings for schools remodeled. Pop. about 30,000.

PUERTO PRINCIPE or **CAMAGÜEY**, province, east of the centre of the island, bounded on the east by Santiago de Cuba, and on the west by Santa Clara; area 11,000 square miles. The north of the province is mountainous, the most of the surface being high tableland affording excellent pasturage. The chief industry is cattle raising, and the number of cattle has largely increased. The finest horses on the island are also raised here. The province is well wooded, and lumbering is an important industry. The minerals include iron, copper and asphalt, all of which are mined to some extent, asphalt being of the most commercial importance. General agriculture is carried on mostly in the vicinity of the town of Puerto Principe, and its port, Nuevitas. Sugar is the most important agricultural product. The province was a centre of the insurrectionary movement, and Cubitas in the northern part was the seat of the insurgent government in 1896–98. Puerto Principe is the second province of Cuba in size but is least densely populated. Pop. about 160,000.

PUERTO REAL, rä-äl', Spain, a seaport in the province of Cadiz, on the Bay of Cadiz, seven miles east of the city of Cadiz. The greater part of the town is modern, on the site of Portus Gaditanus, an old Roman place. It has considerable manufacturing; and the chief products are leather, pottery, linen goods, cements, vermicelli and starch. It has a good harbor and an extensive trade; the chief exports are salt, fruit and manufactures. Pop. about 9,000.

PUERTO RICO, rē'kō. See Porto Rico.

PUERTO DE SANTA MARIA, generally known as «**EL PUERTO**,» dā sän'tä mä-rē'ä (Port Saint Mary), Spain, city in Andalusia, in the province of Cadiz and seven miles northeast of the city of Cadiz, on the Guadalete, near its mouth in the Bay of Cadiz. It is on the railway from Seville to Cadiz. It has a town-house, theatre, a bull-ring, where was given the grand bull-fight to the Duke of Wellington, described by Lord Byron; five promenades, one of them planted with orange and other trees; infantry and cavalry barracks; a custom-house, a good edifice near the mole, a courthouse and a parish church in the Gothic style. Leather, soap, hats, wines, liqueurs, brandies, starch, flour and glass are manufactured, and some fishing is carried on in El Puerto. This is one of the Spanish ports from which sherry is exported. Its vicinity to Cadiz, the centre of exchange, is favorable for trade. The principal articles of import are wood and iron. Steamboats ply regularly between the Puerto and Cadiz. Pop. about 18,000.

PUFENDORF, poo'fĕn-dŏrf, **Samuel,** Baron von, German publicist and historian: b. Chemnitz, Saxony, 8 Jan. 1632; d. Berlin, 26 Oct. 1694. He studied theology and law at Leipzig and in 1657 philosophy at Jena; was tutor in the house of the Swedish ambassador at Copenhagen, and by his work, 'Elementa Jurisprudentiæ Universalis' (1660) secured the appointment, the first in Germany, to the professorship of the law of nature and of nations at Heidelberg in 1661. Here he taught till 1670, and wrote 'De Statu Rei Publicæ Germanicæ,' published in 1667 under the pseudonym of Severinus Mozambano, and which, from the hardy way in which some of the imperfections of the Germanic constitution are exposed, raised a storm of controversy. Partly with a view to escape unpleasant consequences, Pufendorf accepted in 1670 the post of professor of natural law in the university at Lund, offered him by Charles XI of Sweden. He there wrote his work on natural law, 'De Jure Naturæ et Gentium' (1672), which superseded the former; soon after appeared the abstract of this work, 'De Officio Hominis et Civis' (1673), which has passed through numerous editions and been translated into several languages. Pufendorf in these works deviated still further than Grotius from the scholastic method of philosophizing, and consequently excited violent opposition. About 1677 he was appointed secretary of state, royal counsellor, and historiographer at Stockholm. There he wrote in Latin the 'History of Sweden from the Campaign of Gustavus Adolphus in Germany to the Abdication of Queen Christina' (1676), and in German his 'Einleitung zur Geschichte der Vornehmsten Reiche und Staaten' (1682). These works so much increased his reputation that in 1686 he was called to Berlin as counsellor, historiographer, and judge of the Supreme Court of Judicature. In 1690 he was made privy-councillor of the Elector of Brandenburg, and in 1694 was created baron by the king of Sweden. Pufendorf's legal writings are regarded as marking an epoch in the history of natural law, treating it as based upon the social instinct and developing it as a philosophical morality, while allowing scope to revelation.

PUFF-ADDER, the popular name of an African viper (*Bitis arietans*), which should not be confused with the American puffing-adder or blowing-adder, of the genus *Heterodon.* (See Hognose). The hognose adder is harmless, but the African viper is highly dangerous, its head appearing puffed, because of the large size of the poison sacs. See Serpents; Vipers.

PUFF-BALLS. See Fungi.

PUFF-BIRDS, a family (*Bucconidæ*) of tropical American picarian birds, resembling kingfishers in form, but living on insects like flycatchers. They are closely related to the barbets.

PUFFER. See Globe-fish.

PUFFIN, a bird of the auk (q.v.) family, common on all far northern sea-coasts, where they breed on remote cliffs in large companies. The *Fratercula artica* is the most familiar, being distinguished by the large and greatly compressed beak, which is deeply furrowed by three grooves on each side of the mandible. The colors of the beak also add to its singular appearance; this structure being colored bluish-gray at its base, orange-red in the middle and bright red at the tip. A large portion of it is annually molted. The body is short, stout and rounded. These birds excavate burrows in sandy ground, each depositing a single egg of while color. They are able to bite and scratch severely by means of their bills. Puffins swim and dive with great ease; their food consisting of the smaller fishes and chiefly the young of the sprats and herrings. They are caught and their flesh is salted for food by the inhabitants of the Orkney and Shetland Islands. The appearance of the bill in these birds has gained for them the British provincial names "coulter-neb" and "sea-parrot." The crested puffin (*Lunda cirrhata*) has long light yellow plumes rising back of the eyes. Compare Auk; Albatross.

PUG. See Dog.

PUG MILL. See Clay.

PUGAREE, or **PUGREY,** a piece of silk, muslin, etc., worn around a hat or helmet in hot climates, the ends being left hanging, to protect the back, head and neck from the sun.

PUGATSCHEFF, or **PUGACHEV,** poo'-gä-chĕf, **Yemelyan Ivanovitch,** Russian revolutionist: b. Simoweisk, on the Don, Russia, probably between 1730 and 1740; d. Moscow, Russia, 10 Jan. 1775. He was leader of a band of robbers in his early youth, served in the Seven Years' War in the Russian, Prussian and Austrian armies successively and on his return to Russia was implicated in a seditionary movement and imprisoned. He escaped and prompted by his resemblance to the murdered Peter III, pretended to be the tsar. The peasantry flocked to his standard and were promised relief from their oppressions. His forces constantly increased and success for a time attended him. With 16,000 men in his army he captured Kazan, the old Russian capital, and moved upon Moscow, where he was betrayed by his followers to Suvaroff, captured and taken in an iron cage to Moscow, where he was executed.

PUGET, Pierre Paul, pē-ār pŏl pü-zhä, French painter, sculptor and architect: b. Marseilles, 31 Oct. 1622; d. there, 1694. He began his career in art as apprentice to a shipbuilder named Roman, who set him to carving the figure decorations for the prow and poop of galleys which the prevailing fashion demanded. At 17, however, he gave up this pursuit and traveled to Italy on foot, visiting Genoa, Florence and Rome and in the latter place entered the school of Pietro da Cortona. This master's influence was always apparent in Puget's painting. In 1643 he returned to Marseilles and to ship-designing. Later he spent six years at Rome in company with a feuillant monk on a commission from Anne of Austria to make drawings of antique monuments. After 1653 he painted pictures for churches of Marseilles, Aix and Toulon; but finally abandoned painting on the advice of physicians. His first work as a sculptor, the caryatides supporting the balcony of the Hotel de Ville, Toulon, was a venture into realism, the figures being studied from the porters on the quays. These received the praise of Bernini. He produced two works similarly conceived, ‘Hercules Overcoming the Hydra, (now in the Musée de Rouen) and ‘La Terre’ for the Chateau de Vaudreuil, Normandy. His other works are more in the manner of the Italians of the 17th century, an influence confirmed by another visit at the instance of Fouquet. The fall of that minister put an end to his commission and Puget settled in Genoa, where he sculptured a ‘Saint Sebastian and Saint Ambrose’ for the church of Santa Maria-in-Carignano and a ‘Conception’ for the Brignoli, now in the Albergo dei Poveri. His natural restlessness induced his return to France, where he became attached to the arsenal of Toulon as decorator of war vessels. But under the patronage of Colbert he resumed sculpture and executed the ‘Milo of Crotona,’ ‘Alexander and Diogenes’ (bas relief) and later the ‘Perseus and Andromeda,’ all three at present in the Louvre. The ‘Alexander and Diogenes’ has been called «the triumph of picturesque sculpture,» though, as Delacroix has pointed out, its subject is one impossible for sculptural treatment as the ray of sunlight which Alexander intercepts cannot be represented. His architectural works are not numerous, though he erected the church of the Charité and the Capuchines at Marseilles. Consult Lagrange, ‘Pierre Puget, Peinteur, Sculpteur, Architecte’ (1868); Emeric, David, ‘Histoire de la Sculpture Française’ (1872); Auquier, ‘Pierre Puget’ (1903).

PUGET (pū'jĕt) **SOUND** is a large, irregular inlet from the Pacific Ocean into the State of Washington. The Sound proper begins at the junction of Juan de Fuca and Georgia straits and extends south, dividing into two main branches, the eastern one called Admiralty Inlet, and the western Hood Canal. Some of the largest Sound inlets on the east shore are Elliot, Poverty and Commencement bays; on the west shore, Dogfish Bay and Dye's Inlet, and on the south shore, Carrs, Budd and Totten inlets. The area of this great landlocked body of water is about 2,000 square miles. It has a number of islands, Vashon and Bainbridge being the largest. A number of rivers, having their headwaters in the Cascade Mountains, flow into the Sound, the principal river inlets are Duwamish, Nisqually, Nooksak, Puyallup, Skagit, Skokomish and Snohomish. The Sound has a number of large and safe harbors and many miles of deep-water front, and is mostly navigable by large vessels. The waters teem with fish; 95 varieties of food fish have been found. The shores are well-wooded, although there has been extensive lumbering in the surrounding forests. Shipbuilding is a young and growing industry. The annual tonnage entering exceels 2,000,000. A canal is being built to connect with Lakes Washington and Union. The cleared lands in the vicinity make most productive farms. Seattle, Tacoma and Port Townsend are the largest cities on the Sound; all natural conditions exist for an extensive commerce.

PUGET SOUND, College of, a coeducational institution at Tacoma, Wash. It was organized in 1903 under the auspices of the Methodist Episcopal Church as the University of Puget Sound, and was reorganized under its present name in 1914. It has a college preparatory grade leading to its college grade and schools of liberal arts, law, home economics, commerce, education, music and art. Its normal course is approved by the State Board of Education and it conducts a six-weeks summer normal school. The college owns seven and one-half acres of ground in the heart of the city and has excellent buildings. The total enrolment in 1918 was about 400, of whom 18 were with the colors. The president in 1918 was E. H. Todd.

PUGHE, pū, William Owen, Welsh antiquary: b. Tyn y Bryn, Merionethshire, 1759; d. 1835. Going to London at 17 he there met the Welsh literary student Owen Jones, and the two published in 1795 the poems of Dafydd ap Gwilym, a 14th century bard. They subsequently edited other Welsh poems, and, assisted by Edward Williams, published the ‘Myvyrian Archaiology of Wales’ (1801–07). Pughe edited also ‘The Welsh and English Dictionary’ (1793–1803); the ‘Cambrian Biography’ (1803), etc. He accomplished not a little in arousing interest in Welsh language and literature.

PUGILISM. See BOXING; PRIZE FIGHTING.

PUGIN, pū'jĭn, Augustus Charles, English architect and draughtsman: b. Normandy, 1762; d. London, 19 Dec. 1832. He settled about 1798 in London, where for many years he was assistant to the architect Nash. He subsequently devoted his attention to mediæval architecture, and published ‘Specimens of Gothic Architecture selected from various Ancient Edifices in England’ (1821–23). With John Britton he published ‘Architectural Illustrations of the Buildings of London’ (1824). Later works were ‘Specimens of the Architectural Antiquities of Normandy’ (1825–28) with Le Keux; ‘Gothic Ornaments selected from various Buildings in England and France.’

PUGIN, Augustus Welby Northmore, English architect: b. London, 1 March 1812; d. Ramsgate, Kent, 14 Sept. 1852. He early displayed skill and facility in architectural drawing and acted as assistant to the Grieves in painting scenery for Covent Garden and Her Majesty's Theatre. His taste for Gothic art was turned to account in designing the furniture for Windsor Castle, and in supplying Messrs. Rundell and Bridge with designs for mediæval plate. He became a convert in 1834 to Roman Catholicism, and devoted himself thenceforth to the illustration and revival of Gothic architecture in connection with the Roman Catholic Church. His treatise ‘Gothic Furniture and Iron Work’ appeared in 1835, and attracted attention. In the following year he published ‘Contrasts, or a Parallel between the Noble Edifices of the 14th and 15th centuries and Similar Buildings of the Present Day,’ in which he expressed in no measured terms his views as to the decadence of ecclesiastical architecture. Other works of Pugin were ‘The True Principles of Pointed or Christian Architecture’ (1841); ‘An Apology for the Revival of Christian Architecture’ (1843); ‘The Glossary of Ecclesiastical Ornament’ (1844). He was employed by Sir Charles Barry in the decoration of the houses of Parliament, and was connected with Hardman of Birmingham in the manufacture of the renowned Gothic brass-work, besides having a share in the manufactory of stained glass in the same town. Latterly his intellect gave way, from the incessant excitement and labor to which it was subjected, and he was removed to an asylum.

PUISNE (pū'nĕ) **JUDGE,** *in law,* a former term for a younger or inferior judge.

PUJO, Arsène Paulin, American legislator: b. Lake Charles, La., 16 Dec. 1861. He was educated in the public and private schools of Lake Charles and was admitted to the bar in 1886, since when he has been engaged in practice at Lake Charles. He was a member of the Louisiana Constitutional Convention in 1898 and in 1903–13 served in Congress. He was chairman of the committee on banking and currency in 1912, and also chairman of the sub-committee which made the "money trust" investigation in that year. He was chairman of the district board under the Selective Service Act of 1917.

PUKET, poo-kĕt', or **TONKA,** a port of Lower Siam, the chief town of Junk Ceylon or Salang Island, on the west coast of the Malay Peninsula. The town is on the east coast of the island at the entrance to a wide and deep bay. It is the seat of the commissioner of the west coast. Its importance is due to its valuable tin mines yielding an annual average of 3,500 tons. Pop. est. 25,000.

PULANGUI, poo-län'gē, river of the Philippines, the upper part of the Grande de Mindanao. See MINDANAO, GRANDE DE.

PULASKI, pū-lăs'kĭ, **Casimir,** COUNT, Polish soldier of the American Revolution: b. Lithuania, 4 March 1748; d. Savannah, Ga., 11 Oct. 1779. He studied law, served in the army under Charles, duke of Courland, and in 1769 engaged with his father and brothers in the uprising against King Stanislas Augustus. He commanded the insurgents for a time after the death of his father and brothers and in 1771 made an unsuccessful attempt to capture the king at Warsaw which resulted in a sentence of outlawry being passed upon him. Further resistance was soon rendered useless by the coalition of Russia, Austria and Prussia, and Pulaski made his escape to France where he met Franklin and offered his services to the cause of American independence. He obtained letters from Franklin to Washington and in 1777 joined the army of the latter as a volunteer. He performed distinguished service at the battle of Brandywine and received from Congress promotion to the rank of brigadier-general in command of a division of cavalry. He resigned his command after five months, joined the main army at Valley Forge and received permission from Congress to organize an independent corps of cavalry and light infantry which became known as Pulaski's Legion. In 1779 he marched with his men to join General Lincoln in South Carolina where he performed effectual service. In the siege of Savannah he commanded the French and American cavalry and in an assault on 9 October was mortally wounded and was carried on board the United States brig *Wasp* in Savannah harbor where he died two days later. Consult Griffin, 'Count Pulaski' (1910).

PULASKI, Tenn., town and county-seat of Giles County, on Richland Creek 78 miles by rail southwest of Nashville on the Louisville and Nashville Railroad. The Martin Female College and the Massey School for Boys are situated here. It is a well-built town with a central square; is situated in a prosperous agricultural and stock-raising district; and has planing mills, an ice plant and manufactories of tobacco. Pop. 2,928.

PULASKI, Va., town and county-seat of Pulaski County, 50 miles, direct, southwest of Roanoke, on the Norfolk and Western Railroad. It is a growing town with a considerable business as a mountain resort. The district is rich in zinc and iron ores and coal; and there are manufactures of iron and zinc and a sulphuric acid plant. Pop. 4,807.

PULASKI, Wis., a village of Brown County, northwest of Green Bay, the seat of the Polish Franciscan Monastery of the Assumption of the Blessed Virgin and of Seraphic College. Pop. 450. See POLISH FRANCISCANS IN AMERICA.

PULASKI, Fort. See FORT PULASKI.

PULCHERIA, pŭl-kē'rĭ-ạ, Byzantine empress: b. 399; d. 453. She was the daughter of the Emperor Arcadius, upon whose death in 414 she became co-ruler with her brother Theodosius II, who was content to leave the reins of power in her hands. With her two younger sisters she took the vow of virginity, as she was determined that there should be no contests between three husbands for the empire. She condemned the Nestorian and Eutychian heresies and was on the friendliest terms with Cyril of Alexandria, Pope Leo the Great and other great men of the time. She was a fine scholar, earnest in her devotion to the Church and active in promoting the welfare of her subjects. She arranged the marriage of her brother and after the marriage of his daughter with Valentinian III, she retired for a time from the court. On the death of Theodosius, however, in 450 she again assumed the throne, for state reasons was absolved from her vow of virginity and married the general Marcian whom she raised to the throne as her colleague. After her death she was canonized and her feast is still celebrated in the Greek Church.

PULCI, Luigi, loo'jē pool'chē, Italian poet: b. Florence, 15 Aug. 1432; d. Oct. 1487. He came of a family in which poetical talents were hereditary; and had two brothers who were also poets, Bernardo, who wrote elegies on Cosmo de' Medici and translated Virgil's Eclogues, and Luca, who composed stanzas on the Tournament of Lorenzo de' Medici. Luigi far surpassed his elder brothers in talent, and became an intimate of the household of Lorenzo the Magnificent. At the instance of Lucrezia Tornabuoni, mother of Lorenzo, he composed an epic poem, 'Il Morgante Maggiore,' based on the tale of Roland, and recited it canto by canto at the table where such men as Poliziano, Ficino, Michelangelo Buonarotti, and Cristofero Landino gathered. This fact accounts for the diversity of its contents both in respect to the subject matter and the spirit in which it is handled. He assumed the tone of Florentine society at the time of its composition, and inserted at will or to suit the changeable temper of his audiences passages of moving pathos or sincere devotion amid others of coarse buffoonery and broad humor. He fell in with the general Italian tendency of treating the Carlovingian legend with less seriousness than did Northern peoples, but he infused a specially bourgeois spirit by his use of many words of the Tuscan dialect. It has been asserted that Shakespeare's familiarity with Pulci is evidenced in his creation of Iago and Othello. Byron was a confessed admirer, and translated the first canto of 'Morgante Maggiore' which he published with 'Beppo' and the 'Vision of Judgment.' See MORGANTE MAGGIORE; PUNCHINELLO.

PULCINELLO, pŭl-chĭ-nĕl'ō. See PUNCHINELLO.

PULILAN, poo-lē'län, Philippines, pueblo, province of Bulacán, Luzon; on the Quiñgua, five miles above its junction with the Grande de Pampanga, eight miles northwest of Bulacán, the former provincial capital. Pop. 10,100.

PULITZER, pū'lĭt-sėr, **Joseph,** American journalist: b. Budapest, Hungary, 10 April 1847; d. Charleston, S. C., 29 Oct. 1911. He came to the United States in 1864 and joined a Federal cavalry regiment, serving till the end of the Civil War; then became a reporter on the '*Westliche Post,*' which Carl Schurz had made the leading German newspaper in Saint Louis. Beginning upon the lowest round of a journalist's career, and at first enduring considerable hardship, he rapidly won recognition and rose to the position of managing editor and chief proprietor of the paper. In the meantime he had acquired a knowledge of law, had been admitted to practice and been active in politics in the Republican ranks. He was elected to the Missouri legislature in 1869, was a delegate to the convention of the Liberal Republican party at Cincinnati, which nominated Horace Greeley for President, then became a Democrat and in 1874 was a member of the Missouri State constitutional covention. In 1876–77 he was Washington correspondent for the New York *Sun,* and in 1878 bought the Saint Louis *Dispatch* and united it with the *Evening Post* as the *Post-Dispatch.* In 1883 he purchased the New York *World,* soon building up a large circulation. He was elected to Congress in New York in 1885–87 but resigned after a few months. In 1887 his health was broken, due to overwork, and was followed by a steady loss of eyesight until he became totally blind. Mr. Pulitzer's career as an editor was marked by great ability and genius. In August, 1903, announcement was made of the endowment of a College of Journalism by him at Columbia University. He also endowed several scholarships at Columbia College and gave largely to other educational and charitable causes.

PULKOVA (pool'kō-vä) **OBSERVATORY,** in Russia, founded by the Tsar Nicholas, and built in 1835–39, is at the village of Pulkova; lat. 59° 46′ 18″ N., and long. 30° 19′ 40″ E. It was intended for the study of sidereal astronomy. The chief instrument, the refractor, with a 15-inch aperture, was not equaled by any other like instrument in the world, until 1870 when the Newhall Observatory in Newcastle, England, secured a 24-inch refractor. Next came the 26-inch refractor for the Naval Observatory (q.v.) in Washington, D. C. In 1885 the Pulkova Observatory erected a 30-inch refractor made by Clark and Sons of Cambridgeport, Mass. The determinations of star places made at this observatory are regarded as most accurate and its investigations cover a wide field. The observatory is not only doing remarkable original research; but it is also a training school for astronomers and geodesists.

PULLEN, Henry William, English Anglican clergyman and author: b. 29 Feb. 1836; d. 26 Dec. 1903. He was educated at Marlborough and Cambridge, took orders in the English Church, became a minor canon of York in 1862, and was minor canon of Salisbury, 1863–75. He became chaplain of the *Alert* during its Arctic expedition of 1875–76, and for his services on that voyage was awarded the Arctic medal. He attained a sudden fame by the publication in 1870 of the brilliant 'Fight at Dame Europa's School,' of which 193,000 copies were sold and 14 translations made. He also wrote 'Modern Christianity, a Civilized Heathenism' (1872), the circulation of which reached 20,000 copies; 'The Ground Ash, a Public School Story' (1873); 'The Council of Canterbury' (1882); 'The House That Baby Built' (1874); 'Pueris Reventia' (1893); 'Venus and Cupid' (1896); 'Fred and Fritz' (1898). He edited Murray's 'Handbooks to Italy, Rome and Greece' (1886–96).

PULLEY, a mechanical device for the duplication and reduplication of the intensity of a force. By its application the power exerted may overcome a resistance much greater than itself, through a sacrifice of velocity.

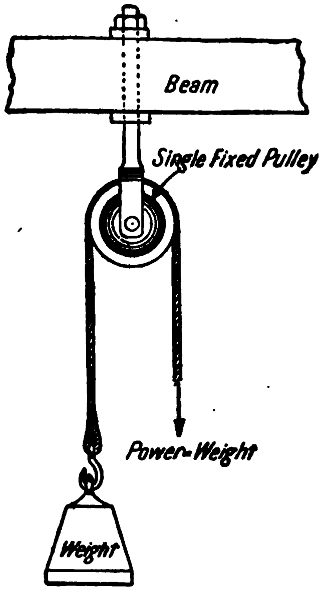


FIG. 1.

In its simplest form it consists of a wheel of wood or metal which turns on a smooth axle attached to a supporting frame, usually in the form of a block. The rim of the wheel is grooved on its outer face so as to allow a rope, cord or chain to pass around it. Its principle of action was first enunciated by Stevin, about 1610, based on the fact that the tension of a rope is the same at every point of its length.

Theoretically a fixed peg in the position of the axis of the pulley would serve the purposes defined just as well as a wheel. The latter is introduced for the specific purpose of reducing the friction.

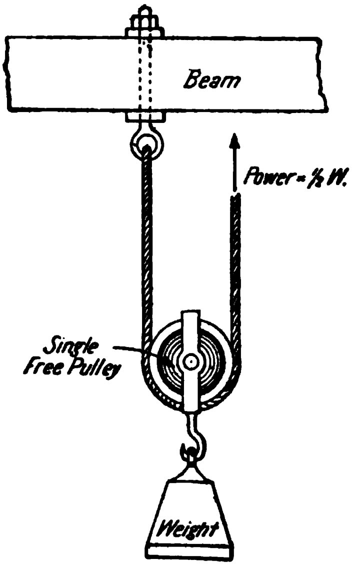


FIG. 2.

In the single «fixed» pulley, Fig. 1, to satisfy the condition of static equilibrium, the tension of the rope must be the same on both sides of the wheel, therefore, the power applied is equal to the weight, and although no mechanical advantage is gained by its use, it serves to change the direction of the force applied. Incidentally, it loads the beam with twice the amount of that force.

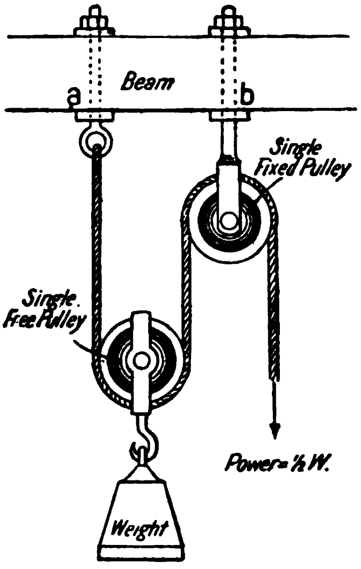


FIG. 3.

In the single movable or «free» pulley with parallel cords, Fig. 2, as in the fixed pulley, the tension of the rope on both sides of the wheel is the same; but, since the weight is supported by two upward forces each of which is equal to the force applied, the power is equal to one half the weight, the beam supporting the other half. In other words, the power that will lift a given weight by the use of a single fixed pulley will lift twice that weight by the employment of a free pulley.

Fixed and free pulleys may be combined in various ways to obtain a mechanical advantage. In the combination shown in Fig. 3, the tension on the beam at (a) is equal to the power applied, and at (b) it is equal to twice that power; but the relation of the power to the weight remains the same as in case of the single free pulley.

If, however, the supporting cords pull at an angle (2ϕ), Fig. 4, the pulley is acted upon by three forces — the weight (w) acting vertically downward, and two equal forces ($p \cos \phi$) acting upward. The resulting effect, $2p \cos \phi = w$, shows a mechanical disadvantage, since the power required increases with the angle, and $p = \frac{1}{2}w$, as shown by Figs. 2 and 3, only when $\phi = 0°$, that is, when the strings are parallel. When $\phi = 60°$, the power is equal to the weight; and when $\phi = 90°$, or $2\phi = 180°$, an infinite amount of power would be required to draw the rope out horizontal.

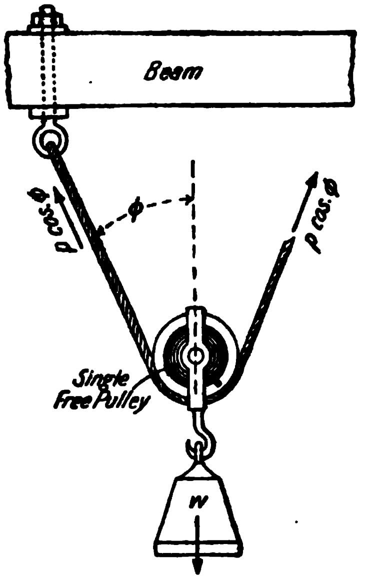


FIG. 4.

Combinations of pulleys or compound pulleys are usually arranged according to one of the three systems represented by Figs. 5, 6 and 7, which indicate the action of the supporting forces.

In the first system, Fig. 5, five independent pulleys are supported by an equal number of branches from the main cord. The mechanical advantage stated in terms of weight (w) and power (p) is $w = 2^5p, = 32p$; or in general $w = 2^n p$, when (n) represents the number of pulleys.

In the second system, Fig. 6, the weight is supported by the four forces, $p + 2p + 2^2p + 2^3p = 15p = (2^4 - 1)p$, or in general, $w = (2^n - 1)p$.

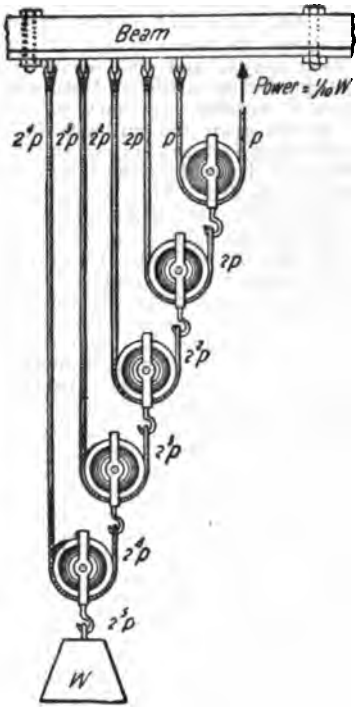


FIG. 5.

In the third system, Fig. 7, one continuous string is divided into six branches by six pulleys, and since the tension of each branch is equal to (p) the power applied, $w = 6p$, represents the mechanical advantage, or $w = np$, when (n) is the number of cords rising from the movable pulley. This is the form most frequently used practically, its most extensive application being the block and tackle devices of the running rigging of ships. See BLOCK; TACKLE.

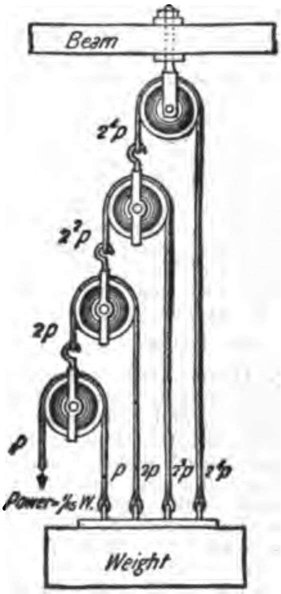


FIG. 6.

The differential pulley is made up of two pulleys of slightly differing diameter, so fastened together that they act as one. An endless chain passes around both, and in one of the bights is a movable pulley: the other bight is used to operate the pulley. As the chain is hauled down from the larger pulley it hoists the chain on the other side, but at the same time the nearer chain on the smaller pulley is unwinding, so that the lifting bight is lessened in length very slowly. The closer the two fixed pulleys approximate the slower the lift, and the greater the power — usually 1 to 60.

The term pulley is used in quite a different sense when applied to the belt-wheels used in power transmission (q.v.). The many formulas given for calculation of their dimensions vary indefinitely with the material of which the pulley-wheel is made, the material and thickness of the belt, and the volume of power transmitted. The width of face of such a wheel is from one-eighth to one-fourth wider than the belt, whose width is determined by the power. In the case of shifting belts the pulley-wheels have a flat face, but otherwise they are slightly crowned, from one-ninety-sixth of the width of the face to as much as one-tenth of such width — as advocated by different authorities. The relative speed of any two pulleys carrying a given belt is inversely as their diameters. To vary the speed at will «step» or «cone» pulleys are in use, the smallest wheel on the driving cone being opposite the largest wheel on the driven cone — and vice versa. Consult Collins, H. E., 'Shafting, Belting and Rope Transmission' (New York 1914); Goodeve, T. M., 'Prin-

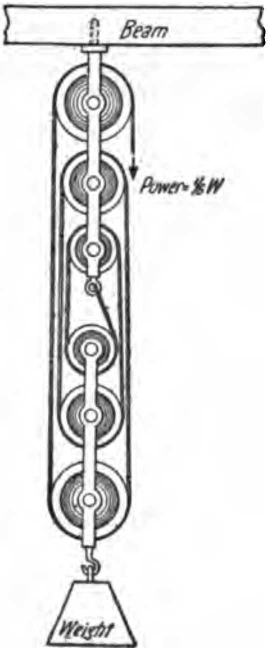


FIG. 7.

ciples of Mechanics' (London 1908); Kent's 'Mechanical Engineer's Pocket Book' (New York 1915).

PULLMAN, George Mortimer, American inventor: b. Chautauqua County, N. Y., 3 March 1831; d. Chicago, Ill., 19 Oct. 1897. He learned the cabinetmaker's trade, and during the construction of the Erie Canal he successfully filled contracts for removing various large buildings in its proposed route. He then settled in Chicago and engaged in building, but devoted much time to the problem of making long railway journeys less tedious, the result being the conversion of two ordinary railway coaches into sleeping cars. They were a success and created a demand for more, and in 1863 he built the «Pioneer» at a cost of $18,000, which was the first of the cars which have since borne his name. He organized in 1867 the Pullman Palace Car Company, of which he was president, and in 1887 originated the vestibule train. He amassed an immense fortune, founded a model town near Chicago, which he named Pullman (q.v.), and was interested in various other large commercial enterprises.

PULLMAN, Ill., a former town, now part of the city of Chicago, on Lake Calumet, 12 miles south of the centre of Chicago. It was founded in 1880 by George M. Pullman, and intended especially for the benefit of the employees of his company. Besides the Pullman Palace Car Company, which is located here, there are car wheel works, a foundry. and other industrial establishments. It was formerly under the government of the Pullman Company, but in 1889 the town voted for incorporation with the city of Chicago (q.v.).

PULLMAN, Wash., city in Whitman County, near the eastern border of the State, 70 miles northeast of Walla Walla, on the Northern Pacific, the Oregon-Washington and the Navigation Company's railroads. The State Agricultural College and School of Sciences are located here as well as a United States Government Experiment Station. The surrounding district produces grain and livestock and dairying also is carried on. The water supply is from artesian wells. The town is growing steadily. Pop. 2,603.

PULMONATA, an order of non-marine gasteropod mollusks, characterized by breathing atmospheric air; the snails. They are usually small, asymmetrical, and provided with a shell. The sexes are always united in the same individual, and the operculum is always wanting, except in *Amphibola*. The respiratory apparatus, which seems to have been modified from that of ancestors who breathed oxygen mixed with water, by means of branchiæ, is not lung-like in structure; it is simply a pouch lined with blood-vessels, and is properly called a pulmonary sac.

PULMOTOR, a machine invented by Bernard Draeger for producing artificial respiration. It was first used in Europe in connection with mine rescue apparatus. Later it was used by the United States Bureau of Mines in similar work. It was found to be so satisfactory in resuscitating after all kinds of suffocation, such as asphyxiation from gas, electric shock and cases of apparently drowned, that large gas and electrical companies have installed them; also many hospitals and fire and police departments.

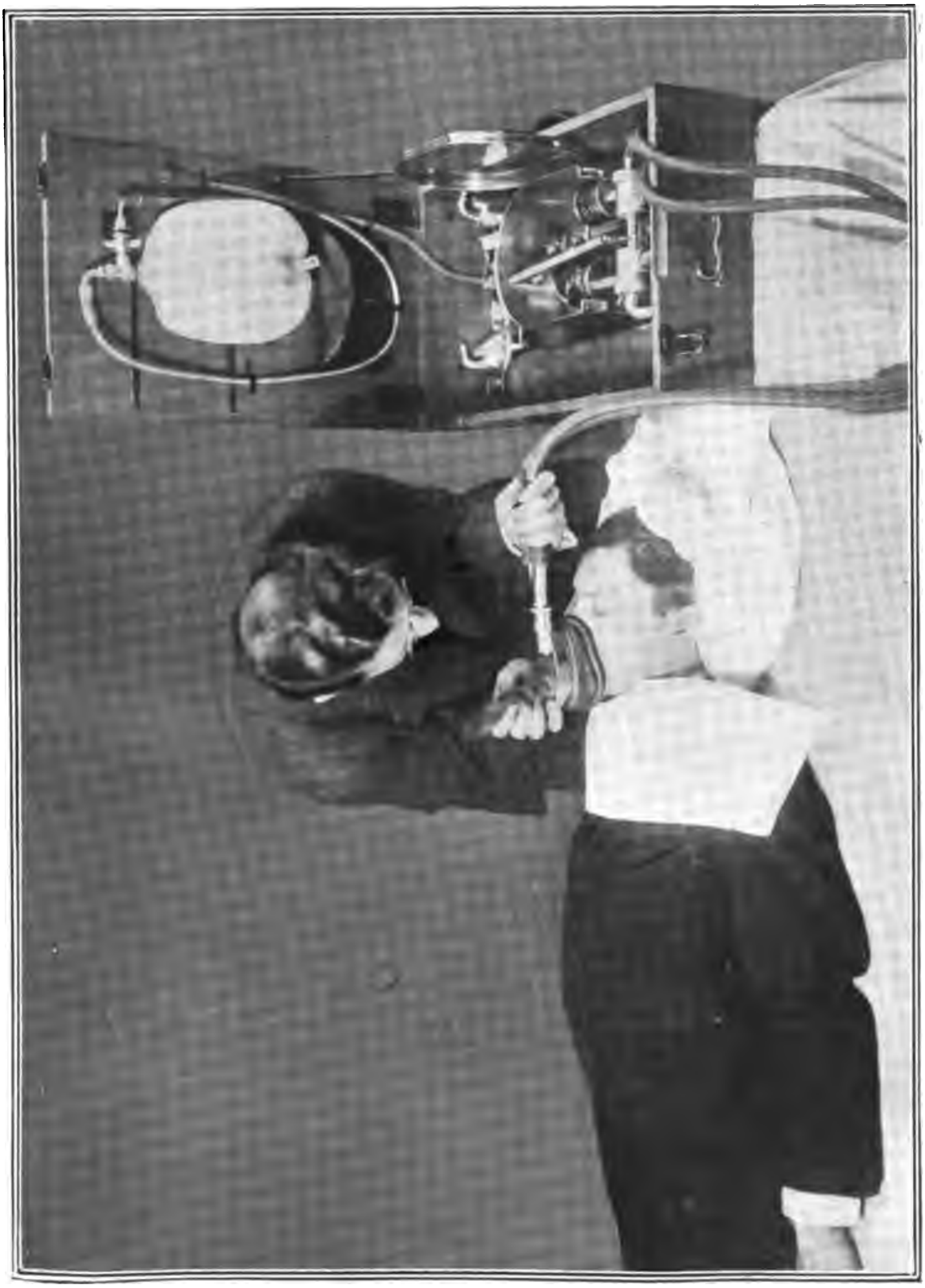
Formerly in cases of asphyxiation, morphine poisoning, drowning, or electric shocks, efforts to restore respiration consisted in laying the patient on his back and alternately pulling his arms over his head and forcing them down upon his chest, thereby causing an expansion of the lung cavity, and then compressing it, thus first producing artificial breathing. In such cases it became necessary to force the patient's mouth open and pull out his tongue, thereby affording free passage for the air, which alternately was drawn into the lung cavity and immediately expelled. This process is superseded by the application of the pulmotor, which operates as follows: An iron cylinder 3½ x 21 inches contains the oxygen at a pressure of about 2,250 pounds when completely filled and will operate the pulmotor 40 minutes continuously. This life-sustaining gas also furnishes the energy which is required to induce breathing, in the following manner: The oxygen from the tank flows through a reducing valve, which at the outlet side maintains a pressure of about 75 pounds, and from there to the controlling valve. Initially, the passage to the lungs is open through this controlling valve. The latter connects two flexible braided copper tubes leading to a metallic face cap with a rubber rim, which closely fits the patient's face. The patient's tongue is drawn down over the lower jaw and under the mask, by means of a set of tongue forceps which is provided. The oxygen then has free access to the lungs.

When the pressure in the lungs has reached a certain value, 20 centimeters, a bellows interconnected with the lung cavity through the flexible braided copper actuates the controlling valve. The pressure of oxygen is now directed so as to create a suction over the connections which lead to the lungs, thereby causing exhalation of the gases previously forced into the lungs. When a vacuum of 25 centimeters is reached in the lungs and bellows, the outer atmosphere acts on the latter, which in turn operates the controlling valve and again admits the oxygen to the lungs. The frequency of these reversals depends upon the size of the lung cavity, a larger space requiring greater time, while with smaller lung cavities the operation is correspondingly more frequent. This process is continued until the patient shows signs of natural respiration. The pulmotor action is then discontinued and the patient is allowed to breathe the pure oxygen through another small face cap connected by a hose directly to the oxygen tank.

PULP. See Paper.

PULSE (from Latin, *pulsus*, a beating), the rhythmical motion of an artery, with alternate expansion and contraction, in practice considered as a beating. This motion is strongest in the heart (q.v.), which is the centre of the arterial system; and from that organ it is propagated through all the minutest branches of the arteries. In those which lie immediately under the skin it can be felt with the finger, as is the case with the radial artery, the pulsation of which is very perceptible at the wrist. The state of the pulse is therefore an indication of the action of the heart and the whole arterial system and of the condition of the blood and the physical functions in general. The circum-

THE PULMOTOR



The Pulmotor and Its Application

stances to be attended to in the pulse are either the number of pulsations which take place in a given time and the regularity or irregularity of their occurrence, or the character of each pulsation. In the former case the pulse is said to be quick or slow according to the number of pulsations in a given interval; regular or irregular, as they occur at equal or unequal intervals. In the latter case it is strong or weak, hard or soft, full or small. It is affected by the age, sex and temperament of the individual, and by accidental circumstances, as sleep, food, exercise, heat.

The pulse is most rapid in infancy, making from 110 to 140 beats per minute. During early childhood it makes from 100 to 110 and is regular and rather soft and small. In youth it is much slower, making from 80 to 90 beats per minute. At this period it is regular, strong, rather soft than hard, moderately full. In mature age the number of beats is on the average about 75 per minute and the pulse is regular, strong, or moderate, fluctuating between hard and soft, between full and small. In old age the number of beats sinks to about 60. In the female the pulse is more rapid, softer and smaller than in the male. In persons of a sanguine temperament it is quicker and fuller than in phlegmatic individuals. Sudden agitation and violent passions make the pulse rapid and irregular; joy makes it quick and strong; long-continued grief, languid and soft. The pulse is, therefore, a highly important indication of the state of the system. A deviation from the regular pulse of an idividual indicates a disordered state. When the irritability of the system is so heightened as to produce fever or inflammation the pulse is accelerated. If the action of the nervous system is irregular, or unduly heightened, the pulse becomes frequent and irregular. In case of mechanical obstructions to the circulation, as in dropsy of the pericardium, polypus in the heart or in the great arteries, the pulse is irregular and interrupted.

The study of the pulse began with the ancients. Galen wrote several works on it and for several centuries the subject of pulsation remained much as he left it. The demonstrations of the circulation of the blood by Harvey and of the irritability of the muscular fibre by Haller threw new light on it, and medical science at last has brought it under full investigation and has explained it in all its physiological aspects. See ARTERIES, DISEASES OF THE; HEART.

PULSE GLASS, an instrument invented by Franklin to exhibit the ebullition of liquids at low temperatures. The bulbs are connected by a slender stem and partially charged with water, the supernatant air having been expelled by boiling and the opening hermetically sealed by a blow-pipe. By grasping one of the bulbs the heat of the hand will cause the formation of vapor and drive the liquid into the other bulb, producing a violent ebullition in the latter.

PULSOMETER. See PUMPS AND PUMPING MACHINERY.

PULSZKY, pûl'skē, **Franz Aurelius**, Hungarian archæologist and publicist: b. Eperies, 1814; d. Budapest, 1897. When only 22 he was nominated to membership in the Archæological Institute of Rome. Joining the Liberal party under Kossuth he was elected a deputy to the Hungarian Diet in 1840 and later under-secretary to the Hungarian Prince Esterhazy, Minister of Foreign Affairs in Vienna. He followed Kossuth to England and after the catastrophe of Villagos accompanied the ex-dictator to America. His impressions of this country were embodied in a book entitled 'White, Red, and Black.' Condemned to death by his country for treason, he lived in Italy and joined cause with the Garibaldians. The sentence was removed in 1866; in 1872 he became inspector-general of museums and public libraries. He wrote 'Philosophy of Hungarian History' (1882); 'My Life and Times'; and 'The Jacobins in Hungary' (1887).

PULTE, pûlt'ĕ, **Joseph Hippolyt**, American physician: b. Meschede, Westphalia, Germany, 6 Oct. 1811; d. Cincinnati, Ohio, 24 Feb. 1884. He took his M.D. at the University of Hamburg and in 1834 came to the United States where he engaged in practice at Cherrytown, Pa. He then adopted homœopathy and later established himself in practice at Cincinnati. With others he founded the American Institute of Homœopathy in New York in 1844; and in 1872 he was instrumental in establishing a homœopathic college in Cincinnati, where he held the chair of clinical medicine. He also held that chair at the Homœopathic College at Cleveland in 1852 and of obstetrics in 1853–55. He edited the *American Magazine of Homœopathy and Hydropathy* in 1852–54 and the *Quarterly Homœopathic Magazine* in 1854. Author of 'The Homœopathic Domestic Physician' (1850); 'A Reply to Dr. Metcalf' (1851); 'The Science of Medicine' (1852), etc.

PULTENEY, pûlt'nĭ, **William**, EARL OF BATH, English politician: b. London, 22 March 1684; d. there, 7 July 1764. He was educated at Oxford, and in 1705 entered Parliament. He was a partisan of Walpole, and after the accession of George I was made privy councillor and secretary of war, 1714–17. In 1725 he became a political opponent of Walpole, gained great popularity by his crusade against his former friend, and when Walpole was forced from the ministry in 1742 Pulteney organized under the Earl of Wilmington a new ministry. The public was disappointed in the cabinet, and his acceptance of a peerage further destroyed his popularity. As member of the House of Lords he was not prominent, and when appointed premier in 1746 he held office but two days, being unable to form a cabinet.

PULTOWA, pool'tōlvä, or **POLTAVA**, Ukraine, (1) capital of a former Russian government; on the Vorskla River, 450 miles southwest of Moscow. It is walled and defended by a citadel on a small eminence. It is the commercial centre of a large farm and stock-raising region. The annual fairs, three in number, are of less importance than in former years. Here in 1709 Peter the Great defeated the Swedes under Charles XII. A monument in the principal square commemorates the event; and three miles from the town is the tomb of those who fell in this battle; it is still called the Swedish tomb. Pop. about 85,000. (2) The government is bounded on the north by Tchernigov, on the east by Kharkov, on the south by Ekaterinoslav, and on the west by Kiev; area, 19,265 square miles. The surface is a plain sloping from the northeast to the southwest, and drained chiefly by the Dnieper and its tributaries. It is one of the most fertile and best cultivated departments of Russia; it exports about one-fourth of the whole produce of wheat, oats and barley of the whole country. Tobacco is increasing in acreage. Stockraising and bee-keeping are given much attention. Manufacturing is limited; the chief products are leather, coarse woolen goods, brandy and saltpeter. Oil is made from the seed of the sunflower and of flax. Pop. about 3,000,000.

PULTUSK, pool'toosk, Russian Poland, town in the government of Lomza, on the Narev, about 32 miles north by east of Warsaw. It has several old buildings of historic interest, some manufactories and considerable trade. It is noted as the scene of the defeat of the Saxons by Charles XII, in 1703, and of the Russians by the French in 1806. Pop. est. 16,000.

PULU, a substance resembling fine silk, of a rich brown color and satin lustre, used largely as a styptic by the medical practitioners of Holland, and introduced into some other countries for the same purpose. It consists of the fine hairs from the stipes of one or more species of tree-fern, referable, to the genus *Cibotium*. It was exported from Hawaii into Britain first in 1844, under the name Pulu, or vegetable silk, and was proposed as a substitute for silk in the manufacture of hats, but could not be applied. In 1856 it was exported from Singapore under the Malay names Penghawar Djambi and Pakoe Kidang, and was said to have been used in Dutch pharmacy for a long period as a styptic. Several importations into western Europe have since taken place.

PULVERMACHER-CHAIN, a form of galvanic battery consisting of a series of small wooden cylinders on which a zinc and a copper wire are coiled side by side, but without touching each other: the zinc of one cylinder, touching the copper of the adjacent one, forms a couple. The whole is immersed in vinegar diluted with water. A chain of 120 couples forms a very powerful battery.

PUMA, or **MOUNTAIN LION.** See COUGAR.

PUMICE, a variety of lava of a porous and fibrous structure, resembling that of a sponge in appearance, containing from 60 to 75 per cent of silica, with alumina, iron, lime, soda, etc. It varies in color from whitish-gray to yellowish-brown and will float in water. It is essentially lava from which steam or gas has escaped in large quantities while it was being consolidated, the bubbles rendering it highly porous. It results from explosive volcanic eruptions. Its extreme roughness fits it for use in polishing. In the solid state it is used to polish paint, wood, metal, etc.; and, as a powder, for marble, ivory, bone, glass, and in the composition ot tooth-powder. Pumice may be considered because of its glassy composition as a porous variety of obsidian (q.v.). Pumice is obtained in Mexico, Iceland and Hungary, but chiefly from the Lipari Islands.

PUMPELLY, Raphael, American geologist: b. Owego, N. Y., 8 Sept. 1837. He was educated at the Owego Academy, and later studied sciences and mining engineering in Paris and at Freiberg, Saxony. He made geological investigations in Corsica, and after his return to the United States in 1860 visited Arizona, and in 1861–63 was engaged in scientific explorations under the government of Japan. In 1863–64 he made a private investigation tour through central, western and northern China and Mongolia, and in 1864 engaged under the Chinese government in examining the northern coal fields. In 1866–73 he was professor of mining at Harvard, State geologist for Michigan in 1869–71, and in 1871–73 directed the State geological survey of Missouri. He was appointed to the United States geological survey in 1879–81, 1884–91, in charge of the Archæan division, and was organizer and director of the Northern Transcontinental Survey in 1881–84. The development of the iron ore industry in Michigan and western Ontario was largely due to his investigations in 1867–1901. In 1903 he explored the Transcaspian country. He has published 'Geological Researches in China, Mongolia and Japan' (1866); 'Iron Ores and Coal Fields of Missouri' (1873); 'Geology of the Green Mountains' (1894); 'Explorations in Central Asia' (1905); 'Prehistoric Civilization of Anan' (1908), etc.

PUMPERNICKEL, a coarse brown bread, originally made in Germany from unbolted rye. It is baked in large square loaves. Its proper manufacture depends upon the treatment of the dough, which must contain neither yeast nor leaven, and also on the management of the oven in which the batch must remain a long time.

PUMPKIN, any of the several annual vine-like herbs, especially *Cucurbita pepo,* of the order *Cucurbitaceæ,* probably of tropical America, but not known in a wild state. It is a coarse tendril-bearing vine frequently exceeding 20 feet in length, with prickly stems and leaf stalks; bears large rough leaves; large yellow flowers, the pistillate being followed by large variously colored but generally yellow fruits, with hard rinds, thick flesh and many seeds. The plant is widely cultivated in warm and temperate countries for its fruits, which range in weight from 10 to 40 pounds but in some varieties weigh far more. They are largely used for stock feeding and for making pies. The cultivation is essentially the same as for squashes; but in America the plants are most frequently grown in corn fields, the seeds being sown at intervals of about 12 feet and the plants allowed to shift for themselves after the corn is laid by. It is affected by the same insect-enemies as the squash (q.v.).

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